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TRANSACTIONS

OF THE

AMERICAN

SURGICAL ASSOCIATION

VOLUME THE THIRTY-SECOND

EDITED BY

ARCHIBALD MACLAREN, M.D.
RECORDER OF THE ASSOCIATION

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1914

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PHILADELPHIA

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OFFICERS OF THE ASSOCIATION

ELECTED APRIL, 1914

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GEORGE E. ARMSTRONG, M.D.

VICE-PRESIDENTS

LEWIS S. PILCHER, M.D.

FRANK E. BUNTS, M.D.

SECRETARY

ROBERT G. LE CONTE, M.D.
1530 Locust St., Philadelphia.

TREASURER

CHARLES L. GIBSON, M.D.
72 East Fifty-fourth St., New York City.

RECORDER

ARCHIBALD MAC LAREN, M.D.
914 Lowry Building, St. Paul, Minn.

COUNCIL

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CHARLES L. GIBSON, M.D.
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} *Ex-officio.*

PUBLICATION COMMITTEE

RECORDER, SECRETARY, AND TREASURER, *ex-officio.*

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ARTHUR W. ELTING, M.D., J. BAPST BLAKE, M.D., PRESIDENT, SECRETARY, RECORDER, AND THE CHAIRMAN OF THE ADJUNCT LOCAL COMMITTEE OF ARRANGEMENTS, *ex-officio.*

COMMITTEE ON NECROLOGY, CREATED IN 1884.

(Report by Title.)

F. H. GERRISH, M.D.
N. B. CARSON, M.D.
WM. L. RODMAN, M.D.

Place of next meeting:

ROCHESTER, MINN.

ADJUNCT LOCAL COMMITTEE OF ARRANGEMENTS

JAMES E. MOORE, M.D., *Chairman*
ARCHIBALD MACLAREN, M.D.
CHARLES H. MAYO, M.D.

DELEGATE TO THE CONGRESS OF AMERICAN PHYSICIANS AND SURGEONS, WASHINGTON, D. C., 1916

WILLIAM H. CARMALT, M.D.
JAMES F. MITCHELL, M.D., *Alternate*

LIST OF THE PRESIDENTS

OF THE

ASSOCIATION FROM THE TIME OF ITS INSTITUTION

ELECTED

1880. †SAMUEL DAVID GROSS, M.D., LL.D., D.C.L. Oxon., LL.D. Cantab., LL.D. Edin.—Founder of the Association.
1883. †EDWARD MOTT MOORE, M.D., LL.D.
1884. †WILLIAM THOMPSON BRIGGS, M.D.
1885. †MOSES GUNN, A.M., M.D., LL.D.
1886. †HUNTER McGUIRE, M.D., LL.D.
1887. †D. HAYES AGNEW, M.D., LL.D.
1888. DAVID WILLIAMS CHEEVER, M.D., LL.D.
1889. †DAVID W. YANDELL, M.D.
1890. †CLAUDIUS HENRY MASTIN, M.D., LL.D.
1891. †PHINEAS SANBORN CONNER, M.D., LL.D.
1892. †NICHOLAS SENN, M.D., Ph.D., LL.D.
1893. JAMES EWING MEARS, A.M., M.D., LL.D.
1894. FREDERIC SHEPARD DENNIS, M.D.
1895. LOUIS McLANE TIFFANY, A.M. Cantab., M.D.
1896. JOHN COLLINS WARREN, M.D., LL.D. (Jefferson), Hon. F.R.C.S. Eng.
1897. †THEODORE F. PREWITT, M.D.
1898. WILLIAM W. KEEN, A.M., M.D., LL.D., Hon. F.R.C.S. Eng.
1899. ROBERT F. WEIR, A.M., M.D., F.R.C.S. Eng.
1900. †ROSWELL PARK, M.D.
1901. †DE FOREST WILLARD, A.M., M.D., Ph.D.
1902. †MAURICE H. RICHARDSON, A.B., M.D.
1903. †NATHANIEL P. DANDRIDGE, M.D.
1904. GEORGE BEN JOHNSON, M.D.
1905. ALBERT VANDER VEER, M.D.
1906. DUDLEY P. ALLEN, M.D., LL.D.
1907. WILLIAM H. CARMALT, M.D.
1908. C. B. G. de NANCRÈDE, A.M., M.D., LL.D.
1909. RUDOLPH MATAS, M.D.
1910. RICHARD H. HARTE, M.D.
1911. ARPAD G. GERSTER, M.D., Chir.D.
1912. CHARLES A. POWERS, A.M., M.D.
1913. WILLIAM J. MAYO, A.M., M.D., D.Sc., F.R.C.S. Edin., LL.D. Tor.
1914. GEORGE E. ARMSTRONG, C.M., M.D.

† Deceased.

NOTICE

This volume of TRANSACTIONS contains the papers read before the Association at the Meeting held April 9, 10, and 11, 1914.

The Association assumes no responsibility for the statements and opinions published in this volume.

FELLOWS

OF THE

AMERICAN SURGICAL ASSOCIATION

APRIL, 1914

* Denotes Original Fellows.
† Denotes Senior Fellows.

ELECTED

1890. ABBE ROBERT, M.D., 13 West Fiftieth Street, New York, Surgeon to St. Luke's Hospital. *Vice-President*, 1901. *Council*, 1908.

†1890. ALLIS, OSCAR HUNTINGTON, A.M., M.D., 1604 Spruce Street, Philadelphia. Surgeon to the Presbyterian Hospital.

1902. ANDREWS, E. WYLLYS, A.M., M.D., 2525 Prairie Avenue, Chicago, Ill. Professor of Surgery, Northwestern University Medical School; Surgeon to Mercy Hospital and Michael Reese Hospital; Attending Surgeon to Cook County Hospital; Consulting Surgeon to the Provident Hospital.

1901. ARMSTRONG, GEORGE E. (*President*), C.M., M.D., 320 Mountain Street, Montreal. Professor of Surgery and of Clinical Surgery, McGill University; Surgeon to the Montreal General Hospital; Surgeon to the Western Hospital, Montreal.

1913. ASHHURST, ASTLEY PASTON COOPER, A.B., M.D., 811 Spruce Street, Philadelphia. Instructor in Surgery in the University of Pennsylvania; Associate Surgeon and Orthopedist to the Episcopal Hospital; Assistant Surgeon to the Philadelphia Orthopædic Hospital and Infirmary for Nervous Diseases.

1906. BARROW, DAVID, M.D., 148 Market Street, Lexington, Ky.

†1882. BARTON, JAMES M., A.M., M.D., 32 North New Hampshire Ave., Atlantic City, N. J.

ELECTED

1900. Bevan, Arthur Dean, M.D., 122 S. Michigan Boulevard, Chicago. Professor and Head of the Department of Surgery, Rush Medical College, University of Chicago; Surgeon to Presbyterian Hospital.

1901. Binnie, J. F., M.B., C.M. (Aberdeen), 1334 Rialto Bldg., Kansas City, Mo. *Vice-President*, 1907.

1906. Blake, John Bapst, A.M., M.D., 657 Boylston Street, Boston, Mass. Instructor in Surgery, Harvard Medical School; Assistant Surgeon to the Boston City Hospital; Surgeon to the Long Island Hospital and St. Elizabeth's Hospital, Boston, Mass.

1902. Blake, Joseph A., M.D., 601 Madison Avenue, New York. Instructor in Surgery, Columbia University; Attending Surgeon to St. Luke's Hospital; Junior Surgeon to the Roosevelt Hospital; Consulting Surgeon to the Northern Dispensary.

1901. Bloodgood, Joseph C., B.S., M.D., 904 North Charles Street, Baltimore, Md. Associate in Surgery in the Johns Hopkins University.

1901. Bosher, Lewis C., M.D., 422 East Franklin Street, Richmond, Va. Professor of Practice of Surgery, Medical College of Virginia; Visiting Surgeon, Memorial Hospital.

1913. Bottomley, John T., A.B., M.D., 165 Beacon Street, Boston. Surgeon-in-Chief, Carney Hospital.

†1890. Bradford, Edward Hickling, A.B., M.D., 133 Newbury Street, Boston. Surgeon to the Children's and the Samaritan Hospitals; Assistant Professor of Orthopedic Surgery, Harvard University.

1900. Brewer, George Emerson, M.D., 61 West Forty-eighth Street, New York City. Professor of Clinical Surgery in College of Physicians and Surgeons, Columbia University; Junior Surgeon, Roosevelt Hospital; Attending Surgeon, City Hospital; Consulting Surgeon to the Ophthalmic and Aural Institute, and to the Perth Amboy Hospital. *Vice-President*, 1913.

1911. Bruce, Herbert A., M D. (Toronto Univ.), L.R.C.P. London, F.R.C.S. England, 64 Bloor Street East, Toronto, Canada. Associate Professor of Clinical Surgery, University of Toronto; Surgeon to the Toronto General Hospital.

1911. Buchanan, J. J., A.M., M.D., Ph.D., 1409 N. Highland Ave., Pittsburg, Pa. Professor of Surgery, University of Pittsburg; Surgeon to Mercy Hospital and to Columbia Hospital.

ELECTED

1900. Bunts, Frank E., M.D., 1021 Prospect Street, Cleveland, Ohio. Professor of Principles of Surgery and Clinical Surgery in Medical College of Western Reserve University; Visiting Surgeon to St. Vincent's Charity Hospital; Consulting Surgeon to Cleveland City and Lutheran Hospitals.

†1885. Carmalt, William H., A.M., M.D., 261 St. Ronan Street, New Haven, Conn. Emeritus Professor of Surgery in Yale University; Consulting Surgeon to the New Haven Hospital, *President*, 1907; *Vice-President*, 1895; *Member of Council*, 1908.

1909. Carrel, Alexis, L.B., Sc.B., M.D., Rockefeller Institute Medical Research, Sixty-sixth Street and Avenue A, New York, N. Y.

1896. Carson, Norman Bruce, M.D., 303 Humboldt Bldg., St. Louis, Mo. Professor of Clinical Surgery in the St. Louis Medical College; Surgeon to St. Louis and Mullanphy Hospitals and to the St. Vincent Insane Asylum, etc. *Vice-President*, 1903.

†1882. Cheever, David Williams, M.D., LL.D., 557 Boylston Street, Boston, Mass. Professor of Surgery (Emeritus) in Harvard University; Surgeon to Boston City Hospital. *President*, 1888.

1896. Cole, Charles Knox, A.M., M.D., Helena, Montana. Surgeon to St. John's, St. Peter's, and County Hospitals.

1898. Coley, William B., M.D., 40 East Forty-first Street, New York. Attending Surgeon to the General Memorial Hospital; Associate Surgeon to the Hospital for Ruptured and Crippled, New York.

1914. Cotton, Frederick J., A.B., M.D., A.M., Brookline, Mass. Assistant Visiting Surgeon, The Boston City Hospital; Instructor in Surgery, Harvard School for Graduate Instruction in Medicine.

1905. Crile, George W., M.D., 1021 Prospect Street, Cleveland, Ohio. Professor of Clinical Surgery, Western Reserve Medical College; Visiting Surgeon to St. Alexis' Hospital; Associate Surgeon to Lakeside Hospital.

1906. Cushing, Harvey, A.M., M.D., The Peter Bent Brigham Hospital, Boston; Professor of Surgery, Harvard University.

1896. Cushing, Hayward Warren, A.B., M.D., 70 Commonwealth Avenue, Boston, Mass. Junior Visiting Surgeon, Boston City Hospital; Assistant Surgeon, Children's Hospital, Boston.

ELECTED

1897. Da Costa, John Chalmers, M.D., 2045 Walnut Street, Philadelphia. Professor of Surgery, Jefferson Medical College; Surgeon to the Philadelphia and the Phœnixville Hospitals.

1909. Davis, Gwilym G., M.D., M.R.C.S. Eng., 1814 Spruce Street, Philadelphia. Associate Professor of Applied Anatomy, University of Pennsylvania; Surgeon to the Episcopal Hospital; Surgeon to St. Joseph's Hospital; Surgeon to the Orthopedic Hospital and Infirmary for Nervous Diseases; Orthopedic Surgeon, Philadelphia General Hospital.

1892. Deaver, John B., M.D., 1634 Walnut Street, Philadelphia. Surgeon-in-Chief to the German Hospital, Philadelphia.

1912. Deaver, Harry C., M.D., 1534 North Fifteenth Street, Philadelphia. Professor of Surgery, Woman's Medical College of Pennsylvania; Surgeon-in-Chief to Kensington Hospital for Women; Surgeon to the Episcopal Hospital and to the Children's Hospital of the Mary Drexel Home.

1910. Delatour, H. Beeckman, M.D., 73 Eighth Avenue, Brooklyn, N.Y. Clinical Professor of Surgery, Long Island College Hospital; Attending Surgeon, St. John's and Norwegian Hospitals; Surgeon-in-Chief, Jewish Hospital; Consulting Surgeon, Kingston Avenue Hospital, Brooklyn, St. Mary's Hospital, Jamaica and Hempstead Hospital.

†1882. Dennis, Frederic Shepard, M.D., F.R.C.S. Eng., 62 East Fifty-fifth Street, New York. Professor of Clinical Surgery, Cornell University, New York City; Visiting Surgeon to the Bellevue and St. Vincent's Hospitals; Consulting Surgeon to St. Joseph's Hospital, Yonkers, and Montefiore Home, New York City. *President*, 1894; *Vice-President*, 1887; *Member of Council*, 1889.

1910. Dowd, Charles N., A.M., M.D., 127 West Seventy-second Street, New York, N. Y. Professor of Clinical Surgery, Columbia University; Attending Surgeon, General Memorial Hospital, New York; St. Mary's Free Hospital for Children, New York; Junior Surgeon, Roosevelt Hospital, New York.

1914. Downes, William A., M.D., 37 West 71st Street, New York, N. Y. Assistant Professor of Clinical Surgery, Cornell Medical School; Attending Surgeon, St. Francis Hospital; Associate Attending Surgeon to the New York, The Babies', and the Hospital for Ruptured and Crippled; Assistant Surgeon to the General Memorial Hospital.

ELECTED

1901. Eliot, Ellsworth, Jr., M.D., 34 East Sixty-seventh Street, New York. Clinical Lecturer and Demonstrator of Surgery, College of Physicians and Surgeons, New York; Surgeon to the Presbyterian Hospital.

†1893. Elliot, John Wheelock, A.M., M.D. (Harvard), 124 Beacon Street, Boston. Surgeon to Massachusetts General Hospital.

1911. Elting, Arthur W., A.B., M.D., 119 Washington Avenue, Albany, N. Y. Professor of Surgery in the Albany Medical College; Surgeon-in-Chief, St. Peter's Hospital; Attending Surgeon to the Albany and the Childs' Hospitals.

1896. Estes, William Lawrence, A.M., M.D., South Bethlehem Pa. Director and Surgeon-in-Chief of St. Luke's Hospital, Lecturer on Hygiene at Lehigh University.

1898. Eve, Duncan, A.M., M.D., 700 Church Street, Nashville, Tenn. Professor of Surgery and Clinical Surgery, Medical Department, Vanderbilt University; Surgeon to the Nashville City Hospital.

1901. Ferguson, Alex. Hugh, C.M., M.D., 100 State Street, Chicago, Ill. Professor of Clinical Surgery in the Medical Department of the University of the State of Illinois; Professor of Surgery in the Post-Graduate Medical School of Chicago; Surgeon-in-Chief of the Chicago Hospital; Surgeon to Cook County Hospital for the Insane; Consulting Surgeon to Provident Hospital.

1899. Finney, John M. T., M.D., 1300 Eutaw Place, Baltimore, Md. Associate Professor of Surgery, Johns Hopkins University.

1904. Frazier, Charles Harrison, M.D., 1724 Spruce Street, Philadelphia, Pa. Professor of Clinical Surgery, University of Pennsylvania; Surgeon to the University Hospital.

1898. Freeman, Leonard, B.S., M.D., 330 Majestic Building, Denver, Col. Professor of Surgery, Gross Medical College; Surgeon to the Arapahoe County Hospital and to St. Anthony's Hospital. *Vice-President*, 1908.

1910. Gage, Homer, A.M., M.D., 72 Pearl Street, Worcester, Mass. Surgeon to Worcester City Hospital, and to Memorial Hospital; Consulting Surgeon to St. Vincent Hospital.

†1882. Gay, George Washington, A.M., M.D., 665 Boylston Street Boston, Mass. Senior Surgeon to the Boston City Hospital, Clinical Instructor in Surgery in Harvard University. *Member of Council*, 1882.

ELECTED

†1892. Gerrish, Frederic Henry, A.M., M.D. (Bowdoin), LL.D. (University of Michigan and Bowdoin), 675 Congress Street, Portland, Maine. Professor of Surgery in the Medical Department of Bowdoin College; Consulting Surgeon, Maine General Hospital.

1890. Gerster, Arpad G., M.D., Chir.D., 34 East Seventy-fifth Street, New York. Professor of Surgery in the New York Polyclinic; Surgeon to the German and Mount Sinai Hospitals. *Vice-President*, 1908; *President*, 1911.

1906. Gibbon, John H., M.D., 1608 Spruce Street, Philadelphia. Professor of Surgery, Jefferson Medical College; Surgeon to the Pennsylvania Hospital and the Bryn Mawr Hospital.

1906. Gibson, C. L., M.D., *Treasurer*, 72 East Fifty-fourth Street, New York, N. Y. Adjunct Professor of Surgery, Cornell University Medical College; Attending Surgeon to the First Surgical (Cornell Medical) Division of the New York Hospital; Consulting Surgeon to St. Luke's, City, and General Memorial Hospitals.

1911. Greenough, Robert B., A.B. (Harvard), M.D. (Harvard), 377 Beacon Street, Boston, Mass. Assistant Professor of Surgery, Harvard Medical School; Assistant Visiting Surgeon, Massachusetts General Hospital.

1908. Guthrie, George W. M.D., 109 South Franklin Street, Wilkesbarre, Pa. Surgeon to the Wilkesbarre City Hospital; Consulting Surgeon to the Pittston Hospital and to the Palmerton Hospital.

1909. Halstead, Albert E., M.D., 31 North State Street, Chicago, Ill. Professor of Surgery, Northwestern University Medical School; Attending Surgeon to the St. Luke's and Cook County Hospitals; Consulting Surgeon to the Illinois Charitable Eye and Ear Infirmary; Lieut. Medical Reserve Corps, U. S. Army.

†1892. Halsted, William Stewart, B.A., M.D., 1201 Eutaw Place, Baltimore, Md. Surgeon to Johns Hopkins Hospital. *Vice-President*, 1913.

1909. Hamann, Carl A., M.D., 404 Osborn Bldg., Cleveland, Ohio. Professor of Anatomy, Western Reserve University; Visiting Surgeon to Charity and City Hospitals.

1898. Harrington, Francis B., A.B. (Tufts College), M.D. (Harvard College), 201 Beacon Street, Boston, Mass. Surgeon to Massachusetts General Hospital.

ELECTED

1900. HARRIS, MALCOLM L., M.D., 100 State Street, Chicago, Ill. Professor of Surgery, Chicago Polyclinic; Attending Surgeon, Alexian Brothers' Hospital, St. Luke's Hospital, and Maurice Porter Hospital for Children.

1895. HARTE, RICHARD H., M.D., 1503 Spruce Street, Philadelphia. Associate Professor of Surgery, University of Pennsylvania; Surgeon to the Pennsylvania Hospital, and Orthopedic Hospital and Infirmary for Nervous Diseases; Consulting Surgeon to St. Mary's, St. Timothy's, and Bryn Mawr Hospitals. *President*, 1910.

1898. HEARN, W. JOSEPH, M.D., 1120 Walnut Street, Philadelphia. Clinical Professor of Surgery, Jefferson Medical College; Visiting Surgeon to the Philadelphia Hospital; Consulting Surgeon to the Phœnixville General Hospital.

1909. HOTCHKISS, LUCIUS WALES, A.B., M.D., 59 West Forty-eighth Street, New York. Adjunct Professor of Clinical Surgery, Columbia University; Attending Surgeon to Bellevue Hospital; Junior Surgeon to Roosevelt Hospital; Consulting Surgeon to J. Hood Wright Hospital, New York City.

1901. HUNTINGTON, THOMAS W., A.B., M.D., LL.D., 350 Post Street, San Francisco, California. Professor of Clinical and Operative Surgery (Emeritus), College of Medicine, University of California; Consulting Surgeon, St. Luke's Hospital, San Francisco. *Vice-President*, 1906.

1913. HUTCHINSON, JAMES ALEXANDER, M.D. C.M., 354 Mackay St., Montreal. Professor of Surgery and Clinical Surgery, McGill University; Attending Surgeon, Montreal General Hospital.

1909. HUTCHINSON, JAMES P., M.D., 133 South Twenty-second Street, Philadelphia. Surgeon to the Pennsylvania, Methodist, Children's, St. Timothy's and Bryn Mawr Hospitals.

1913. JACKSON, JABEZ N., A.M., M.D., 425 Argyle Building, Kansas City, Mo.

1901. JOHNSON, ALEXANDER B., M.D., 12 East Fifty-eighth Street, New York. Professor of Clinical Surgery, Cornell University Medical College; Attending Surgeon to New York Hospital.

1905. JOHNSON, ROBERT W., A.B., M.D., 101 W. Franklin Street, Baltimore, Md. Professor of Principles and Practice of Surgery, Baltimore Medical College; Surgeon to Maryland General Hospital, Church Home and Infirmary, and St. Agnes' Hospital.

ELECTED

1896. Johnston, George Ben, M.D., 405 East Grace Street, Richmond, Va. Professor of the Practice of Surgery and of Clinical Surgery in the Medical College of Virginia; Surgeon to the Old Dominion Hospital; Consulting Surgeon to the Richmond City Free Dispensary. *President*, 1904; *Member of Council*, 1907.

1901. Jonas, A. F., M.D., 454 Brandeis Building, Omaha, Nebraska. Professor of Surgery, Omaha Medical College; Surgeon to the Methodist Episcopal Hospital and to the Douglas County Hospital. *Vice-President*, 1906.

1910. Jopson, John Howard, M.D., 1824 Pine Street, Philadelphia, Pa. Professor of Surgery, Philadelphia Polyclinic; Associate in Surgery, University of Pennsylvania; Surgeon to Presbyterian Hospital, Children's Hospital, and Bryn Mawr Hospital.

1914. Judd, Edward Starr, M.D., Rochester, Minn., Surgeon to St. Mary's Hospital.

1899. Kammerer, Frederic, M.D., 51 East Sixty-sixth Street, New York City. Professor of Clinical Surgery, Cornell Medical College; Surgeon to the German and St. Francis' Hospitals, New York.

1913. Kanavel, Allen B., A.B., M.D., 31 North State Street, Chicago, Ill. Assistant Professor of Surgery, Northwestern University Medical School; Attending Surgeon to Wesley and Cook County Hospitals.

*†1880. Keen, William Williams, A.M., M.D., LL.D., Hon. F.R.C.S. Eng. and Edin., 1729 Chestnut Street, Philadelphia. Emeritus Professor of the Principles of Surgery and of Clinical Surgery in the Jefferson Medical College; Surgeon to the Jefferson Medical College Hospital; Consulting Surgeon to the Woman's and St. Agnes' Hospitals; Membre Correspondant Etranger de la Société de Chirurgie de Paris; Membre Honoraire de la Société Belge de Chirurgie. Ehreunitglied der Deutschen Gesellschaft für Chirurgie. Honorary Member, Clinical Society of London. *President*, 1898; *Vice-President*, 1892; *Member of Council* 1899–1901.

1911. Kiliani, Otto G. T., M.D., 44 West 77th St., New York City. Professor of Clinical Surgery, Columbia University; Surgeon to the German Hospital.

ELECTED

1911. King, Alfred, A.B., M.D., Sc.D. (Colby), 610 Congress Street, Portland, Maine. Lecturer on Surgery in the Medical School of Maine; Consulting Surgeon to the Maine Hospital.

1901. Le Conte, Robert G., A.B., M.D., *Secretary*, 1530 Locust Street, Philadelphia. Surgeon to the Pennsylvania and the Bryn Mawr Hospitals; Consulting Surgeon to the Germantown and the Gynecean Hospitals.

1912. Lewis, Dean D., M.D., 122 S. Michigan Ave., Chicago, Ill. Assistant Professor of Surgery, Rush Medical College; Attending Surgeon to the Presbyterian Hospital, Chicago.

1910. Lilienthal, Howard, A.B., M.D., 48 East Seventy-fourth Street, New York, N. Y. Attending Surgeon, Mount Sinai Hospital; Visiting Surgeon to Bellevue Hospital: Consulting Surgeon, Hospital for Joint Diseases, Jewish Maternity Hospital, and Har Moriah Hospital.

1908. Lothrop, Howard Augustus, A.M., M.D., 101 Beacon Street, Boston, Mass. Assistant Visiting Surgeon, Boston City Hospital; Instructor in Surgery, Harvard Medical School.

1910. Lund, Frederick Bates, M.D., 527 Beacon Street, Boston, Mass. Lecturer on Surgery, Harvard Medical School; Visiting Surgeon, Boston City Hospital.

1903. Lutz, F. J., A.M., M.D., 3337 Lafayette Place, St. Louis, Mo. Professor of Surgery, Medical Department, St. Louis University: Surgeon-in-Chief, Alexian Brothers' Hospital; Surgeon-in-Charge, Josephine Hospital.

1901. McArthur, L. L., M.D., 122 S. Michigan Boulevard, Chicago, Ill. Professor of Clinical Surgery, Post-Graduate Medical School; Assistant Professor of Clinical Surgery, Rush Medical College; Surgeon to St. Luke's and Michael Reese Hospitals.

1882. McGraw, Theodore A., M.D., 73 Case Street, Detroit, Mich. Professor of Surgery in the Detroit Medical College; Surgeon to St. Mary's and Harper Hospitals. *Vice-President*, 1896.

1903. McMurtry, Lewis S., A.M., M.D., LL.D., 542 Atherton Building, Louisville, Ky. Professor of Gynecology and Abdominal Surgery in the Medical Department, University of Louisville; Surgeon to the Louisville City Hospital.

ELECTED

1908. Mackenzie, Kenneth A. J., M.D., L.R.C.P., and L.R.C.S., Edin., 908 Corbett Building, Portland, Oregon. Professor of Operative Surgery, Medical Department Oregon State University; Surgeon to St. Vincent's Hospital, Portland, Oregon

1904. MacLaren, Archibald, M.D., B.S., *Recorder*, 914 Lowry Building, St. Paul, Minn. Professor of Clinical Surgery, University of Minnesota.

1914. MacLaren, Murray, B.A., M.B.C.M., M.D., M.R.C.S., Eng., 75 Coburg Street, St. John, N. B., Canada. Surgeon to the General Public Hospital.

*†1880. Marks, Solon, M.D., 136 Wisconsin Street, Milwaukee, Wis. Surgeon to St. Mary's Hospital. *Vice-President*, 1898.

1898. Martin, Edward, M.D., 1506 Locust Street, Philadelphia. Clinical Professor of Surgery, University of Pennsylvania and Woman's Medical College of Pennsylvania, Philadelphia; Surgeon to Philadelphia, St. Agnes', and Howard Hospitals.

†1895. Mastin, William McDowell, M.D., LL.D., Northeast corner of Joachim and Conti Streets, Mobile, Ala. Surgeon to the Mobile City Hospital.

1895. Matas, Rudolph, M.D., 2255 St. Charles Avenue, New Orleans, La. Professor of Surgery, Medical Department, Tulane University; Professor of Clinical Surgery, New Orleans Polyclinic; Surgeon to Charity Hospital; Consulting Surgeon to the Eye, Ear, Nose, and Throat Hospital. *President*, 1909; *Vice-President*, 1901.

1903. Mayo, Charles, H., A.M., M.D., LL.D., Rochester, Minn. Surgeon to St. Mary's Hospital.

1899. Mayo, William J., A.M., M.D., D.Sc., F.R.C.S. Edin., LL.D. Tor., 427 West College Street, Rochester, Minn. Surgeon to St. Mary's Hospital. *Vice-President*, 1903; *President*, 1913.

*†1880. Mears, James Ewing, A.M., M.D., LL.D., 1535 Land Title Building, Philadelphia. *President*, 1893; *Recorder*, 1881–93.

1901. Meyer, Willy, M.D., 700 Madison Avenue, New York. Professor of Surgery in the New York Post-Graduate Medical School and Hospital; Attending Surgeon to the German and New York Skin and Cancer Hospitals; Consulting Surgeon to the New York Infirmary for Women and Children.

1912. Mitchell, James F., A.B., M.D., 1344 Nineteenth Street, Washington, D. C. Surgeon to Providence Hospital.

ELECTED

1893. Minter, Samuel Jason, S.B. (Massachusetts Institute of Technology), M.D. (Harvard), 180 Marlborough Street, Boston. Surgeon to Massachusetts General Hospital and to Carney Hospital; Consulting Surgeon to Massachusetts Charity Eye and Ear Infirmary; Instructor in Surgery, Harvard University.

†1896. Monks, George Howard, A.B. (Harvard), M.D. (Harvard), M.R.C.S. (Eng.), 67 Marlborough Street, Boston. Junior Visiting Surgeon, Boston City Hospital; Lecturer on Surgery, Harvard Medical School and Harvard Dental School.

1895. Moore, James E., M.D., 616 Syndicate Bldg., Minneapolis, Minn. Professor of Surgery, University of Minnesota; Surgeon-in-Chief to the Northwestern Hospital. *Vice-President*, 1905.

1914. Moschcowitz, Alexis V., M.D., 925 Madison Ave., New York, N. Y. Associate Surgeon, Mt. Sinai Hospital; Attending Surgeon, Hor Moriah Hospital.

1904. Mudd, Harvey G., M.D., Humboldt Building, St. Louis, Mo. Professor of Fractures and Dislocations and Clinical Surgery, Medical Department, Washington University; Surgeon to St. Luke's Hospital; Consulting Surgeon to the St. Louis City Hospital.

1906. Mumford, J. G., M.D., 29 Commonwealth Ave., Boston, Mass. Instructor in Surgery, Harvard Medical School; Visiting Surgeon to the Massachusetts General Hospital.

1913. Murphy, Fred T., A.B., M.D., Washington University Medical School, St. Louis, Mo. Professor of Surgery, Washington University Medical School; Surgeon-in-Chief, Washington University Hospital and St. Louis Children's Hospital.

1902. Murphy, John B., A.M., M.D., 2526 Calumet Ave., Chicago, Ill. Professor of Surgery, Medical Department of Northwestern University, Chicago Post-Graduate School and Hospital, and Chicago Clinical School; Attending Surgeon to Mercy Hospital, Cook County Hospital, and Wesley Hospital; Consulting Surgeon to the Alexian Brothers' Hospital and Hospital for Crippled Children.

1898. Murray, Francis W., M.D., 32 West Thirty-ninth Street, New York City. Professor of Clinical Surgery in Cornell University Medical College; Surgeon to the New York and St. Luke's Hospitals.

ELECTED

†1882. DE NANCRÈDE, C. B. G., A.M. (University of Pennsylvania), M.D., LL.D. (Jefferson), 504 South State Street, Ann Arbor, Mich. Professor of Surgery in the University of Michigan; Professor of Surgery, Dartmouth Medical College. *President*, 1908; *Vice-President*, 1889 and 1899.

1903. NEILSON, THOMAS R., M.D., 122 South Seventeenth Street, Philadelphia, Pa. Surgeon to the Episcopal Hospital and to St. Christopher's Hospital for Children; Clinical Professor of Genito-urinary Diseases in the University of Pennsylvania.

1900. OCHSNER, A. J., B.S., F.R.M.S., M.D. Eng., 710 Sedgwick Street, Chicago. Professor of Clinical Surgery, College of Physicians and Surgeons; Surgeon-in-Chief of Augustana and St. Mary's Hospitals.

1900. OLIVER, J. C., M.D., 628 Elm Street, Cincinnati, Ohio. Dean and Professor of Operative Surgery, Miami Medical College; Surgeon to Cincinnati, Presbyterian, and Christ Hospitals.

†1882. OWENS, JOHN E., M.D., 1017–18 Venetian Building, Chicago, Ill. Professor of Principles and Practice of Surgery and Clinical Surgery in the Chicago Medical College; Surgeon to St. Luke's Hospital. *Vice-President*, 1900.

1899. PARHAM, FREDERICK WILLIAM, M.D., 741 Carondelet Street, New Orleans, La. Professor of General, Clinical, and Operative Surgery on the Cadaver, New Orleans Polyclinic; Surgeon to Charity Hospital; Consulting Surgeon to Eye, Ear, Nose, and Throat Hospital.

†1893. PARMENTER, JOHN, M.D., 519 Franklin Street, Buffalo, N. Y. Professor of Anatomy and Clinical Surgery in the Medical Department of the University of Buffalo; Surgeon to the Sisters of Charity, Erie County, Fitch, Children's, and Emergency Hospitals; Assistant Surgeon to the Buffalo General Hospital.

1908. PECK, CHARLES HOWARD, M.D., 30 West Fiftieth Street, New York City. Associate in Surgery, Columbia University; Attending Surgeon to French Hospital; Junior Attending Surgeon to Roosevelt Hospital.

1889. PILCHER, LEWIS S., A.M., M.D., LL.D. (Dickinson), 386 Grand Avenue, Brooklyn, N. Y. Professor of Clinical Surgery in the Post-Graduate Medical School, New York; Surgeon to the Methodist Episcopal Hospital, New York. *Vice-President*, 1893.

ELECTED

1914. Plummer, Samuel C., A.B., M.D., 4539 Oakenwald Avenue, Chicago, Ill. Attending Surgeon, St. Luke's Hospital; Clinical Professor of Surgery, Northwestern University Medical School; Chief Surgeon, C. R. I. & P. Ry. Co.

1914. Pool, Eugene Hillhouse, A.B., M.D., 107 East 60th Street, New York, N. Y. Attending Surgeon, French Hospital; Associate Attending Surgeon, New York Hospital; Instructor of Surgery, Columbia University; Consultant Surgeon to New York Orthopædic and Manhattan State Hospitals, and Home for Incurables.

1904. Porter, Charles Allen, A.M., M.D., 245 Beacon Street, Boston, Mass. Assistant Surgeon to the Massachusetts General Hospital; Instructor in Surgery, Harvard Medical School.

1896. Powers, Charles A., A.M., M.D., Fourteenth and Stout Streets, Denver, Col. Professor of Clinical Surgery in the University of Colorado, and Surgeon to St. Luke's Hospital and to the Children's Hospital; Consulting Surgeon to the Mercy Hospital and to the State Home for Children. *President*, 1912; *Vice-President*, 1903; *Member of Council*, 1908.

1908. Primrose, Alexander, M.B., C.M. Edin., M.R.C.S. Eng., 100 College Street, Toronto, Canada. Surgeon to the Toronto General Hospital and to the Hospital for Sick Children, Toronto; Associate Professor of Clinical Surgery in the University of Toronto.

1886. Ransohoff, Joseph, M.D., F.R.C.S. Eng., 19 West Seventh Street, Cincinnati, Ohio. Professor of Anatomy in the Medical College of Ohio; Surgeon to the Cincinnati and the Good Samaritan Hospitals. *Vice-President*, 1911.

1901. Rixford, Emmet, B.S., M.D., 1795 California Street, San Francisco, Cal. Professor of Surgery in Cooper Medical College; Surgeon to City, County, and Lane Hospitals. *Vice-President*, 1905.

†1882. Roberts, John B., A.M., M.D., 313 South Seventeenth Street, Philadelphia. Professor of Anatomy and Surgery in the Philadelphia Polyclinic; Surgeon to the Methodist and Jewish Hospitals. *Vice-President*, 1888 and 1894; *Treasurer*, 1892–93.

1898. Rodman, William L., A.M., M.D., 1904 Chestnut Street, Philadelphia. Professor of Surgery, Medico-Chirurgical College, Philadelphia.

ELECTED

1914. Ross, George Gorgas, M.D., 1721 Spruce Street, Philadelphia, Pa. Visiting Surgeon, Germantown Hospital; Assistant Surgeon, German Hospital.

†1882. Rushmore, John Dikeman, M.D., 129 Montague Street, Brooklyn, N. Y. Professor of Surgery in the Long Island College Hospital; Surgeon to the Brooklyn, St. Peter's, and the Eye and Ear Hospitals.

1909. Scudder, Charles L., M.D., A.B., Ph.B., 209 Beacon Street, Boston, Mass. Surgeon to the Massachusetts General Hospital; Associate in Surgery at the Harvard Medical School.

1902. Shepherd, Francis J., M.D., 152 Mansfield Street, Montreal, Canada. Professor of Anatomy and Lecturer on Operative Surgery in McGill University, Montreal; Senior Surgeon to the Montreal General Hospital.

1905. Sherman, Harry M., A.B., M.D., A.M., 350 Post Street, San Francisco, Cal. Professor of Surgery in the University of California; Surgeon to St. Luke's Hospital, San Francisco; Orthopedic Surgeon to the Children's Hospital, San Francisco.

†1895. Souchon, Edmond, M.D., 2403 St. Charles Avenue, New Orleans, La. Professor of Anatomy and of Clinical Surgery, Tulane University; Surgeon to Charity Hospital; Consulting Surgeon to the Eye, Ear, Nose, and Throat Hospital. *Vice-President*, 1899.

1914. Starr, Frederic Newton Gisborne, M.B., M.D.C.M., 112 College Street, Toronto, Canada. Associate Professor of Clinical Surgery, University of Toronto; Surgeon to Hospital for Sick Children, and to St. John's Hospital for Women; Senior Assistant Surgeon, Toronto General Hospital.

1911. Stewart, Francis T., M.D., 311 S. 12th Street, Philadelphia, Pa. Professor of Clinical Surgery, Jefferson Medical College; Surgeon to Germantown Hospital; Out-patient Surgeon, Pennsylvania Hospital.

1909. Stillman, Stanley, M.D., 2201 Buchanan Street, San Francisco, Cal. Professor of Surgery, Cooper Medical College; Surgeon to Lane Hospital and City and County Hospital.

1912. Stokes, Charles F., A.M., M.D., D.Sc., LL.D., Washington, D. C. Surgeon-General, United States Navy.

ELECTED

1909. Summers, John Edward, M.D., 618 Brandeis Theatre Bldg., Omaha, Neb. Surgeon to the Clarkson Memorial, the Wise Memorial, and the Douglass County Hospitals, Omaha, Neb.

1900. Taylor, William J., M.D., 1825 Pine Street, Philadelphia. Surgeon to the Orthopædic Hospital and Infirmary for Nervous Diseases, and to St. Agnes' Hospital; Consulting Surgeon to the West Philadelphia Hospital for Women.

1909. Thompson, James E., M.D., 3224 Broadway, Galveston, Texas. Professor of Surgery in the University of Texas Medical School; Surgeon to the John Sealy Hospital.

†1885. Thompson, J. Ford, M.D., The Cosmos Club, Washington. D. C. Professor Emeritus of Surgery, Medical Department, George Washington University.

†1882. Tiffany, Louis McLane, A.M. (Cantab.), M.D., 831 Park Avenue, Baltimore, Md. *President*, 1895; *Member of Council*, 1883–89; 1896–97.

†1882. Vander Veer, Albert, A.M., M.D., Ph.D., LL.D., 28 Eagle St., Albany, N. Y. Professor of Surgery, Albany Medical College; Surgeon-in-Chief, Albany Hospital; Consulting Surgeon, Albany Free Dispensary Association; Consulting Surgeon, Benedictine Hospital, Kingston, N. Y., and Champlain Valley Hospital, Plattsburgh, N Y.; *President*, 1905; *Vice-President*, 1898; *Member of Council*, 1907.

1910. Vander Veer, Edgar Albert, Ph.B., M.D., 28 Eagle Street, Albany, N. Y. Clinical Professor of Surgery, Albany Medical College; Attending Surgeon, Albany Hospital; Consulting Surgeon, Champlain Valley Hospital.

1902. Vaughan, George Tully, M.D., 1718 I Street, Washington, D. C. Professor of Principles and Practice of Surgery, Georgetown University; Professor of Surgery and Genito-urinary Surgery, Washington Post-Graduate Medical School; Chief Surgeon, Georgetown University Hospital; Surgeon, Emergency Hospital; Consulting Surgeon, Government Hospital for the Insane, Washington, D. C.; Assistant Surgeon-General U. S. Public Health and Marine Hospital Service.

1891. Walker, Edward W., M.D., 30 Garfield Place, Cincinnati, Ohio. Professor of Surgery, Miami Medical College.

ELECTED

1909. WALKER, JOHN B., M.D., 33 East Thirty-third Street, New York, N. Y. Surgeon to the Bellevue Hospital; Assistant Surgeon to the Hospital for Ruptured and Crippled, New York.

†1882. WARREN, JOHN COLLINS, M.D., LL.D. (Jefferson), Hon. F.R.C.S. Eng. 58 Beacon Street, Boston, Mass. Professor of Surgery in Harvard University; Surgeon to the Massachusetts General Hospital. *President*, 1896; *Vice-President*, 1890; *Member of Council*, 1897.

†1896. WATSON, FRANCIS SEDGWICK, A.B., M.D., 92 Marlborough Street, Boston. Surgeon to the Boston City Hospital; Instructor in Genito-Urinary Surgery, Harvard Medical School.

1913. WATTS, STEPHEN H., M.A., M.D., Department of Surgery, University of Virginia, Charlottesville, Va. Professor of Surgery and Gynecology in the University of Virginia; Surgeon-in-Chief, University of Virginia Hospital.

†1889. WEIR, ROBERT F., A.M., M.D., HON. F.R.C.S. Eng., Cor. Mem. Surg. Soc., Paris, 11 East Fifty-fourth Street, New York. Professor of Surgery in the College of Physicians and Surgeons, Columbia University; Surgeon to the Roosevelt Hospital. *President*, 1899; *Member of Council*, 1893–1896; 1901–03.

1892. WHARTON, HENRY R., A.M., M.D., 1725 Spruce Street, Philadelphia. Surgeon to the Presbyterian, Children's, and Methodist Hospitals.

†1882. WHITE, J. WILLIAM, M.D., PH.D., 1810 South Rittenhouse Square, Philadelphia. John Rhea Barton Professor of Surgery in the University of Pennsylvania.

1914. WINSLOW, RANDOLPH, A.B., M.D., A.M., LL.D., 1900 Mt. Royal Terrace, Baltimore, Md. Professor of Surgery, University of Maryland; Chief Surgeon, University Hospital; Surgeon, Hebrew Hospital; Consulting Surgeon to Union Hospital, Elkton, Md., and to James L. Kernan Hospital for Crippled Children, Baltimore.

1901. WOOLSEY, GEORGE, M.D., 117 East Thirty-sixth Street, New York City. Professor of Anatomy and Clinical Surgery, Cornell University; Surgeon to Bellevue Hospital; Associate Surgeon to the Presbyterian Hospital.

SENIOR FELLOWS

ALLEN, DUDLEY P., A.M., M.D., LL.D., 8811 Euclid Avenue, Cleveland, Ohio.

ALLIS, OSCAR H., M.D., 1604 Spruce Street, Philadelphia, Pa.

BARTON, JAMES M., M.D., 32 North New Hampshire Ave., Atlantic City, N. J.

BRADFORD, E. H., M.D., 133 Newbury Street, Boston, Mass.

CARMALT, WILLIAM H., M.D., 261 St. Ronan St., New Haven, Conn.

CHEEVER, D. W., M.D., 557 Boylston Street, Boston, Mass.

DENNIS, FREDERIC SHEPARD, M.D., F.R.C.S. ENG., 62 East 55th Street, New York., N. Y.

ELLIOTT, JOHN WHEELOCK, A.M., M.D., 124 Beacon Street, Boston, Mass.

GAY, GEORGE W., 665 Boylston Street, Boston, Mass.

GERRISH, FREDERIC H., A.M., M.D., LL.D., 675 Congress Street, Portland, Me.

HALSTED, WM. S., M.D., 1201 Eutaw Place, Baltimore, Md.

KEEN, W. W., M.D., 1729 Chestnut Street, Philadelphia, Pa.

MARKS, SOLON, M.D., 136 Wisconsin Street, Milwaukee, Wis.

MASTIN, WM. M., M.D., Northeast corner Joachim and Conti Streets, Mobile, Ala.

MEARS, JAMES EWING, A.M., M.D., LL.D., 1535 Land Title Building, Philadelphia, Pa.

MONKS, GEORGE H., A.B., M.D., M.R.C.S., 67 Marlborough Street, Boston, Mass.

DE NANCRÈDE, C. B. G., A.M., M.D., LL.D., 504 South State Street, Ann Arbor, Mich.

Owens, John E., M.D., 1201 Venetian Building, Chicago, Ill.

Parmenter, John, M.D., 519 Franklin Street, Buffalo, N. Y.

Roberts, John B., A.M., M.D., 313 South Seventeenth Street, Philadelphia, Pa.

Rushmore, John D., M.D., 129 Montague Street, Brooklyn, N. Y.

Souchon, Edmund, M.D., 2103 St. Charles Ave., New Orleans, La.

Thompson, J. Ford, M.D., The Cosmos Club, Washington, D. C.

Tiffany, L. McLane, M.D., 831 Park Avenue, Baltimore, Md.

Vander Veer, A., A.M., M.D., Ph.D., LL.D., 28 Eagle Street, Albany, N. Y.

Warren, J. Collins, M.D., 58 Beacon Street, Boston, Mass.

Watson, Francis S., A.B., M.D., 92 Marlborough Street, Boston, Mass.

Weir, Robert F., M.D., 11 East Fifty-fourth Street, New York, N. Y.

White, J. William, M.D., Ph.D., 1810 S. Rittenhouse Square, Philadelphia, Pa.

HONORARY FELLOWS

ELECTED

1907. Ballance, Charles Alfred, M.D., M.S., University of London, F.R.C.S. (Eng.), 106 Harley Street, London.

1891. Bryant, Thomas, F.R.C.S. (Eng.), 65 Grosvenor Place, Grosvenor Square, W., London.

1891. Chiene, John F.R.C.S. Edin., M.D. Edin., 26 Charlotte Square, Edinburgh, Scotland. Professor of Surgery in the University of Edinburgh.

1885. Czerny, Prof. Dr. Vincent, 25 Sophien Strasse, Heidelberg, Germany. Professor of Surgery in the University of Heidelberg.

1911. von Eiselsberg, Freiherr Anton, Vienna, Austria. Professor of Surgery, Vienna University.

1910. Friedrich, Prof. P. L., 19 Bahnhofstr., Marburg, Germany. Professor of Surgery, University of Marburg.

1890. Horsley, Sir Victor Alexander Haden, F.R.C.S. Eng., 25 Cavendish Square, W., London.

1894. Kocher, Prof. Dr. Theodor, 25 Villette, Berne, Switzerland. Professor of Surgery, University of Berne.

1894. Macewen, Sir William, M.D., M.B., M.S., 3 Woodside Cresent, Glasgow, Scotland.

1908. Moynihan, B. G. A., M.S. Lond., F.R.C.S., 33 Park Square, Leeds, England. Surgeon to the Leeds Infirmary.

1907. Myles, Sir Thomas, M.D., F.R.C.S.I., 33 Merrion Square, N., Dublin, Ireland.

1907. Pozzi, Professor S., Avenue de Jena, Paris, France. Professor of Surgery, University of Paris.

ELECTED

1903. Robson, A. W. Mayo, M.D., F.R.C.S., D.Sc., 8 Park Crescent, Portland Place, London, W., England. Vice-President, Royal College of Surgeons of England; Hunterian Professor of Surgery and Pathology.

1882. Smith, Stephen, A.M., M.D., LL.D., 574 Madison Avenue, New York. Professor of Clinical Surgery in the University Medical College of New York; Surgeon to the Bellevue and St. Vincent's Hospitals. *Vice-President*, 1890.

1912. Stiles, Harold Jalland, M.B., F.R.C.S. Edin., 9 Great Stuart Street, Edinburgh, Scotland. Surgeon to Chalmers Hospital and to the Royal Edinburgh Hospital for Sick Children, Edinburgh.

1914. Thomson, Alexis, B.M., M.S., M.D., (Edin.), M.R.C.S. (Eng.). Professor of Surgery, University of Edinburgh, 39 Drumsheugh Gardens, Edinburgh, Scotland.

1907. Trendelenburg, Prof. Dr. F., Leipzig, Germany. Professor of Surgery, University of Leipzig, Germany.

REPORT OF THE COMMITTEE ON NECROLOGY

MAURICE HOWE RICHARDSON

Maurice Howe Richardson, after a life crowned by exceptional activity and unvarying success, was found dead in his bed at home in Boston, on the morning of July 31, 1912. He had received every honor that hospital and school could offer, and died at the zenith of his powers, without knowing the progressing and paralyzing infirmities of age.

Dr. Richardson was graduated from Harvard College with the class of 1873; in the ninth report of the secretary of the class, published in June, 1913, it is written that "he was the son of Nathan H. and Martha A. (Barber) Richardson, and was born at Athol, Massachusetts, December 31, 1851." After graduation he taught for a year at Salem, Mass., at the same time studying medicine with Dr. Edward B. Peirson, whose daughter he subsequently married. He entered the Harvard Medical School as a second-year student, and, after taking his degree in 1877, was appointed surgical interne at the Massachusetts General Hospital, a position he resigned after three months to become private assistant to the demonstrator of anatomy. From this time his advance was rapid, and he held successively the offices of assistant in anatomy at the Harvard Medical School (1877), demonstrator in anatomy (1882), assistant in surgery (1883), assistant professor of anatomy (1887), assistant professor (1895), associate professor (1902), and professor of clinical surgery (1903), and Moseley professor of surgery (1907), a position he held until his death. His connection with the Massachusetts General Hospital lasted throughout his professional life, and he was in turn appointed surgeon to outpatients (1882), visiting surgeon (1886), and surgeon-in-chief (1910), a position created especially for him. He was consulting surgeon to many institutions. He was a charter member of the Société Internationale de Chirurgie, president of the American Surgical Association, and chairman of the Surgical Section of the American Medical Association. He was also a prolific writer on topics concerning his profession. In his connection with the hospital and medical school he was thrown into close relationship with Dr. Oliver Wendell Holmes

—a circumstance to which he largely owed the marvelous knowledge of anatomy, which was one of his many distinguished attainments. He was one of the earliest surgeons who adopted operative interference in cases of appendicitis, in the management of which he was conspicuously successful, and which pointed the way to his ultimate specialty of general abdominal surgery. In connection with other Boston practitioners he built the private hospital on Corey Hill in Brookline, and took special pride in its control, which lay largely in his hands. He was an indefatigable worker, rarely taking a rest from his labors; he died in harness, passing away in his sleep. His wife and six children survive him.

Though a life-long New Englander, puritan austerity and aloofness were not parts of his nature; rather was he genial, warm-hearted, cheerful, affectionate, optimistic, profoundly human. But only those to whom he came in the hours of black grief knew the whole of him; to these unfortunates he brought the delicacy and intuition of a woman, the strength and vigor of a man, the touch and knowledge of a surgeon, the spiritual support and reinforcement of an old friend.

Those who were present at his funeral at King's Chapel in the rushing midday of a busy city, will never forget the spontaneous and unabashed expression of deep affection which a great multitude of citizens of all classes offered to his memory. They crowded the chapel and the streets, stopping traffic and business, willingly coming from all distances and directions to look upon his face, and to uncover their heads in his honor. It was indeed a sight seldom witnessed in Boston; not only a source of consolation to his family, but equally the sort of tribute and recognition, which he himself would most have wished, and most highly have valued.

He was a man of enormous physical strength; it is recorded that he swam from the Harvard Boat House down the winding Charles, and across the harbor to South Boston Point, and from the mainland through dangerous currents to the island of Martha's Vineyard, and that he walked from Fitchburg to the top of Mount Monadnock and back in a single day. Fishing and shooting were favorite sports of his, because they took him perforce into the sunshine and the open, and dragged him temporarily away from the fascination of the operating-room. He rose early and worked late; few men could have stood up for a month to the continuous and colossal daily routine which was his pleasure and his pride for years; and from this stand-point, lucky was he to drop in an instant all his powerful strength, instead of being doomed to feel it slowly wilt and vanish in the declining rays of a setting sun.

His colleagues knew him as an operator of rarest skill and finish —direct, determined, fearless—one who loved his work deeply, and honored anatomy as the pre-anesthetic surgeons honored it. His delight in dissection remained ever with him. Not only did he with his scalpel unerringly lay bare the most delicate tissues of the body, but with equal facility portray them on the board with his crayon, before the eyes of his admiring students. Yet his thought was always first for the best good of the patient, never for the exaltation of pure technique alone, nor for the intricate operative procedure as such. With his unusual skill he bent to the needs of the suffering all the most complicated modern surgical methods, and to his patients he came, holding in his potent fingers the instruments of his perfect craft, the symbols of his exceptional power. He was truly a type of the beloved physician, whose presence increased hope and happiness, whose knowledge diminished sorrow and pain, whose personality instilled confidence and courage, and if need be, resignation.

To the Fellows of this Association he was particularly dear; to each one he seemed literally an old intimate friend; his memory remains with us as a vital thing, his warm personality as a lasting reality; and we know that he, who looked forward to each succeeding annual meeting with so much keen anticipation, is still of us and among us, though we do not see his face. J. B. B.

NATHAN JACOBSON, M.D.

Nathan Jacobson was born June 26, 1857, in Syracuse, New York, which was his home during his entire life. He received the medical doctorate from the College of Medicine of Syracuse University in 1877, spent a year in Vienna under the best masters, and then entered upon his career as a practitioner. At first, although in general practice, he gave particular attention to diseases of the upper respiratory tract, and in their treatment achieved so much reputation that, in 1885, he was made instructor in laryngology in the school from which he was graduated. In 1888 he became lecturer on laryngology and clinical surgery, and professor in the same department in the following year. In 1892 he abandoned laryngology for the wider field of general surgery, and was made professor of clinical surgery, holding that chair until he was promoted to the professorship of surgery in 1906.

He was a member of various medical societies in this city, county,

and state, including the New York Academy of Medicine, and served as president of several of them; and he belonged, also, to the Société Internationale de Chirurgie.

He was surgeon to and trustee of St. Joseph's Hospital, consulting surgeon to the Syracuse Hospital for Women and Children, and consultant to the New York State Hospital for Epileptics at Sonyea. He was one of the organizers and directors of the Jewish Orphan Asylum of Central and Western New York.

He was foremost in every measure to improve the sanitary condition of the community, being a member of the Public Health Committee of the Syracuse Academy of Medicine, of the Onondaga Medical Society, and of the Chamber of Commerce; of the Commission to Safeguard the Waters of Skaneateles Lake; and of the Advisory Board to the Commissioner of Public Safety. He was an earnest and powerful advocate of the establishment of a tuberculosis hospital for the county of Onondaga, and of the medical inspection of public schools.

He wrote many papers and addresses for county, state, and national societies, and they were always marked by the erudition, clearness, force, and sincerity that were characteristic of the man.

In 1883, Dr. Jacobson married Minnie Schwartz, of Buffalo, New York, who, with an adult son and daughter, survive him.

On September 16, 1913, while visiting a patient in a hospital, he died, without the slightest warning that his end was near.

Dr. Jacobson began his career with an inadequate preliminary education, a fact which he fully appreciated; but he was blessed with a vigorous constitution, a wonderful fund of energy, a keen intellect, and a high and honorable ambition; and he amply atoned for the deficiencies of his preparation by the study of the best authors in several languages, by his quick and accurate observation, and his mental acquisitiveness. He had a trained and well-stored mind; his knowledge of medical literature was profound. His methods were characterized by precision, persistence, tirelessness; his industry was well directed and indomitable; his attention to details, as in recording and classifying his cases, was perfect. He was a master of diagnosis, a profound reasoner, a judicious adviser, a skilful, careful, thorough operator, and a devoted attendant in the after-treatment. He was an admirable teacher, inspiring to his students, and, hence, secured excellent results. But, besides all these fine qualities, he possessed moral and personal attributes which won the respect of all who knew him, and the love of those with whom he was intimate. He was absolutely honest and truthful, his sense of justice was keen, his

kindness won affection, his geniality and wit made him a delightful companion. Generosity, unselfishness, and love for all mankind were as conspicuous in his nature as were his intellect, fidelity to duty, and energy. His life was replete with noble deeds, and ended at the very summit of his distinguished career.

ARTHUR TRACY CABOT, M.D.

Dr. Cabot, the son of Samuel and Hannah Lowell (Jackson) Cabot, was born in Boston on the fifth of January, 1852, and died there on the fourth of November, 1912. In 1882 he married Susan Shattuck, who survives him without children. He received the bachelor's degree in arts at Harvard in 1872, the master's in 1878, and the doctorate in medicine in 1876. After a year of postgraduate study in Vienna and Berlin, he returned to his native city, which thereafter was the scene of his activities.

In the death of Arthur Cabot not only does this Association lose one of its most respected and valued Fellows, but other important interests are deprived of a service that he rendered to them with rare ability, devotion, and steadfastness. The sphere of his influence and the application of his powers and public spirit may, in part, be seen in the enumeration of the offices which he held in various institutions. These were principally as follows: Visiting, and afterward consulting, surgeon to the Massachusetts General Hospital, the Children's Hospital, and the New England Hospital for Women and Children; Fellow of the Corporation of Harvard University; chairman of the Massachusetts Commission on Hospitals for Consumptives; president of the Massachusetts Association for the Prevention of Tuberculosis; president of the Massachusetts Medical Society; member of the American Association of Genito-urinary Surgeons; trustee of the Boston Museum of Fine Arts; Fellow of the American Academy of Arts and Sciences.

A wide and varied sphere of arduous work is indicated in this list of his life's service to his fellows. The duties of each of these positions he performed with ability and the utmost thoroughness, and his influence in each one of them was strong and beneficial.

As a general surgeon his work was admirable in all respects, and in the branch to which he gave especial attention—surgery of the genito-urinary system—he was preëminent. All his professional work

was characterized by its painstaking, careful quality, by a properly conservative restraint, by sound judgment and great thoroughness. In whatever he did professionally he never lost sight of one chief motive which governed his action: to do that which was safest for the patient, and which offered him the greatest chance of benefit. Arthur Cabot was the sort of surgeon in whose hands one would place oneself with implicit trust. If we apply the final test of our opinion to the quality of his surgical abilities, that lies in the answer to the question, "Which surgeon would I most of all desire to have operate upon and care for me, in case I required the services of a surgeon?" we find a great many of his confrères who would have selected him before all others. His contributions to surgery were marked by the same characteristics that were apparent in his operative work, and were of much value on account of the saneness of judgment, scientific accuracy, and well-balanced consideration of the subjects, with which they dealt.

He had a keen artistic sense, and a wide knowledge of works of art, as well as much love for them; and, in his position as Trustee of the Boston Art Museum, they gave an especial value to his service. His fealty to his Alma Mater and his devotion to her best interests in the same way made his influence felt as a Fellow of her Corporation.

These are but the dry details of a life that might be that of any one of dozens of men—they were all admirable, all of great usefulness. But it was something more that Arthur Cabot possessed, that lent to each and all of his works a distinctive quality, such as very few men impress upon their service to their fellows. It was from his qualities as a man that this impression was given. It was, in short, that one essential quality of human beings that no one can present in the written word—the spirit of the man—that made Arthur Cabot and his works what they were. If the memories of all, whom he has helped, could be gathered into one story, we should find in the gratitude with which those memories of him were associated, a picture of some part, at least, of his spirit. If we could trace the qualities he possessed by virtue of his descent from the Puritan people, who were his ancestors in large part, and if we could show the modification that was impressed upon them and how the rigor of their strength was tempered by the warmth of heart and the broad sense of humanity that he infused into them, we should receive another view of his spirit; for these were among the chiefly determining traits and natural attributes that directed him, and that gave such great help and comfort to so many persons.

His integrity was absolute, his condemnation of all that was in his

eyes wrong was absolute: but he rendered a gentler judgment to the evil-doer than to his acts, for he knew human nature, its frailties, and its possibilities of being uplifted, and had the quality of understanding that helps to lift the ill-doer while leaving him no doubt of the condemnation of his unworthy acts.

By temperament he was reserved, and had not the traits that win a quick popularity with people in general, nor would he have desired to do so. He was as steadfast a friend as could be found.

When in thought, his face wore a grave and sometimes a stern expression; but nothing could exceed the charm and warmth of the smile with which he greeted a friend, and which banished the serious look from his face.

His tastes included the things that belong to out-door life and sports. He knew the language of the trees and flowers, and loved to hold converse with them. He was a good cross-country rider and a crack shot. These avocations supplied a relaxation, of which he stood greatly in need oftentimes.

His public spirit was strong, and was exhibited in the varied function, included in the offices which he held, and to which he gave his energies to the fullest limit of his endurance and strength.

The inadequacy of one's effort to bring before us something even of his personality and character makes only more vivid to one's mind how noble were his attributes. We can but be grateful to him for the inspiration that we received from his example, and for having been given to know the knightly quality of the spirit, which animated him throughout his life, and with which, it may be added, he met his death.

F. S. W.

ROSWELL PARK, M.D.

Roswell Park was born in Pomfret, Connecticut, May 4, 1852. His parents early removed to Wisconsin, where his father, the Rev. Roswell Park, founded Racine College, from which Dr. Park received in 1872 his baccalaureate and in 1875 his master's degree. He was graduated in medicine at Northwestern University in 1876. He was demonstrator of anatomy in the Woman's Medical College, Chicago, 1877–79; adjunct professor of anatomy in Northwestern University, 1879–82; lecturer on surgery in Rush Medical College in 1882; professor of surgery in the University of Buffalo, and surgeon to the Buffalo General Hospital from 1883 until his death. He received the

honorary degrees of M.D. from Lake Forest University in 1890, A.M. from Harvard University in 1895, and LL.D. from Yale in 1902. He was non-resident professor in the Army Medical School, and had been president of the American Surgical Association, the Medical Society of the State of New York, the American Association for the Advancement of Science, and the Buffalo Academy of Medicine. He was the father of the New York State Institute for the Study of Malignant Disease and the first chairman of its board of trustees, being appointed for life. For nine years he was the surgeon of the Fourth Brigade of the National Guard of the State of New York. He was a member of the German, French, and Italian Surgical Associations, and of many social, artistic, musical, scientific, and philanthropic organizations, and of several of them he had been president. In 1890 he was offered the chair of surgery in Rush Medical College, but declined the invitation, preferring to devote himself to the interests of his adopted city.

When the Société Internationale de Chirurgie was projected he was the first American to be consulted in the matter, and it was to his recommendation that the sixty surgeons who were the first on this side of the Atlantic to be invited to participate in the new organization owed the opportunity to become members. But for his untimely death, he, as chairman of the committee of arrangements on behalf of our Association for the Entertainment of the International Society at its fourth triennial meeting—the first one away from the continent of Europe—would now be displaying his perfect skill and refined taste as a representative host, and charming our foreign guests with his brilliant intellect and gracious personality.

Dr. Park's bibliographic record is very long and includes articles on a great variety of topics. It must suffice to mention here only *Lectures on Surgical Pathology* (1891); *A Treatise on Surgery by American Authors* (1896), of which he was editor and the contributor of many chapters, and which passed through three editions; *The History of Medicine* (1897); *The Principles and Practice of Modern Surgery* (1907), and *The Evil Eye, Thanatology, and Other Essays* (1913). All of his writings displayed learning, originality, admirable taste, and delightful literary style.

In 1880 he married Martha P. Durkee, of Chicago, who died in 1899. For a long series of years his health had been precarious, and he had many alarming illnesses; but for a considerable period before his death he had been fairly well. In the early morning of February 15, 1914, he awakened with strange sensations, and called his son to his aid. In a few minutes he became unconscious, and died within a half-hour. Two adult sons and a sister survive him.

Dr. Park was thirty-one years of age when he assumed the chair of surgery in the University of Buffalo, just vacated by the able and venerated Moore. With becoming modesty and appreciation of his task, he entered upon his work, and quickly made a name for himself, his school, and his city, which grew with the years, and today seems ineffaceable.

The foundation and superstructure of his fame were the result of qualities of mind and heart, which strengthened and graced his professional youth, and broadened and mellowed throughout his whole life. To make tomorrow better than today was his constant effort. When he came to Buffalo his progressiveness stood in marked contrast to that of the great majority of his professional associates. It is not too much to say that he gave the first real impulse to modern pathology and bacteriology in his new field. A command of several foreign languages, together with unusual lucidity of tongue and pen, made his contributions of foreign work and his own personal opinions mark an epoch then and there. Thus from the beginning he took the leadership, which he maintained until his death. This leadership, which, in its beginning, was confined to professional affairs, soon extended to things outside of medicine. Added to his progressive spirit was a deep sense of his obligation as a citizen to his community, and to the various causes, to which he gave most generously of his time, thought, and money, as many societies and institutions in Buffalo mutely, but eloquently, attest. In art, in music, in philanthropy, in civil government, in short, in all the usual interests and activities of a city, his voice and pen and purse were at command. In later years he took an increasing interest in the history of medicine, in philosophy, and in the phenomena and mystery of life and death. While he was devoting so much time and effort to outside affairs, his fame was increasing by leaps and bounds, soon to become international, with memberships in foreign societies, honorary degrees, and other insignia of professional rank. There may have been surgeons greater in technical skill and in diagnostic acumen, though he was remarkable in both these respects, but there have been few who have equalled him in that happy blending of sterling common-sense and surgical accomplishment. He was a conservative radical in the truest and best sense of the word, to which trait many thousands of his patients owe life and health. Great as was Dr. Park as a surgeon and as a citizen, he was yet greater as a man and a friend. Through years of distress of body and mind he never complained. With his earthly affairs shaped to meet an apparently inevitable end on more than one occasion, he never flinched; and when, without money and

with a staggering obligation, he was advised by business friends of wisdom and probity to accept bankruptcy, he repudiated the suggestion with unconcealed disgust, asking only for health and strength to perform his part, which, fortunately for his peace of mind, he was soon to do. Linked with this strength was the tenderness of a child's heart, a tenderness that often made him the victim of the unscrupulous, who used his name and money for questionable ends. He would, however, rather have been the victim a hundred times than have done injustice once. Whether a guest at his table, a young man struggling for recognition, a patient sick and sore, a beggar at his door, or a deserving cause, to all he was ever the same courteous, thoughtful, and considerate helper. His physical, mental, and moral forces were at the beck and call of all who were deserving or dear to him. It is hard to give its real value to a character such as his. We know the many sick he comforted and restored, the despondent and discouraged he put heart into, the causes and institutions, to enumerate which would weary, to which he gave new life and vigor. To those with whom he did not come into actual contact, but who knew of him rather than the man himself, his example of untiring industry, his progressive spirit, and his many-sided interest spread its contagion. He led the indifferent to endeavor, and inspired the ambitious to gain higher planes of thought and action. If a real man is one whose body, mind, and soul are impregnated and fortified with true grit, and smoothed and rounded by brotherly love; whose highest ideals are embodied in service to others; whose memory brings unbidden tears to many eyes, then Roswell Park was such a man. J. P.

JOSEPH DECATUR BRYANT, M.D., LL.D.

The death of Joseph Decatur Bryant in New York, on April 7, 1914, removed from the ranks of the medical profession one of its ablest and most influential members. Born in East Troy, Wisconsin, March 12, 1845, son of Alonzo and Harriet Atkins Bryant, he had just entered his seventieth year.

His education was obtained in the public schools of Wisconsin, and the Norwich (New York) Academy. He graduated from Bellevue Hospital Medical College in 1868, and entered Bellevue Hospital in 1869 as an interne. With both of these institutions he was connected for the most of the remaining years of his life. When he died

he had been a visiting surgeon of Bellevue Hospital for over thirty years, and had held since 1898 the chair of the Principles and Practise of Surgery in New York University and Bellevue Hospital Medical College. Prior to 1898 he had filled in succession the positions of assistant to the chair of anatomy, professor of anatomy, and professor of the principles and practice of surgery in Bellevue Hospital Medical College.

A list of the positions which he had occupied, public and educational, is long. He was president of the New York State Medical Association, 1904; of the Medical Society of the State of New York, 1905–6; of the American Medical Association, 1907. He was deeply and actively interested in the New York Academy of Medicine, its president from 1895 to 1897, and a trustee for many years thereafter, taking an active part in the raising of funds for the institution. He was a member of many of the smaller and more intimate medical clubs and societies of New York.

He was a visiting surgeon to St. Vincent's Hospital, New York, and consulting surgeon to the New York City Insane Asylum, Northwestern Dispensary, Hospital for the Ruptured and Crippled, and the Woman's Hospital. He was, also, a consulting surgeon to St. John's and St. Joseph's Hospitals, Yonkers.

Dr. Bryant was a veteran of the 71st Regiment, National Guard of the State of New York, and its surgeon from 1873 to 1882. In the latter year he was appointed surgeon-general of the National Guard of the State of New York, with the rank of brigadier, serving throughout the administrations of Governors Grover Cleveland, David B. Hill, and Roswell P. Flower.

Beyond this he found time to write one of the best manuals of operative surgery in the language, a work in two volumes, which has run through several editions; he contributed numerous papers to medical encyclopedias and magazines, and more recently was editor-in-chief, with the late Albert M. Buck, of the *American System of Surgery*, in eight volumes. In 1908 the degree of LL.D. was conferred on him by the New York University. The above is by no means a complete list of his positions and achievements, but it serves to indicate the breadth of his intellectual and scientific activities.

Dr. Bryant possessed a fine sense of public duty, which he always obeyed, often at great sacrifice to his personal and private affairs. The energy with which he attempted to forward the interests of the American Medical Association and the New York Academy of Medicine, indeed, of all the various institutions with which he was at different times connected, is sufficient evidence of that quality. His

connection with the New York Board of Health and the vigorous policies which he instituted there are still fresh in the minds of the older members of the profession in that city.

As a teacher, he was surpassed by few, if any. His first teaching was in a country school, that training table of so many vigorous and rugged intellects. After graduation he instituted a quiz, at that time in vogue, in which, covering practically all the major subjects of medicine, he prepared men for graduation. So popular did this quiz become that he was soon noticed by, and invited to become a part of, the faculty. Later, as already mentioned, he held the chair of the Principles and Practice of Surgery in the New York University and Bellevue Hospital Medical College. His strength as a teacher lay in the fact that he emphasized principles, instituted comparisons, formulated classifications; hence he was an educator in the broader sense of the word, teaching men to think, as well as acquire facts. He carried the same methods into surgery, and his analysis of a case in conference or clinic was so interesting and instructive as to invite the presence of many outside the ranks of medical students.

One of the most striking characteristics of Dr. Bryant was his intense love of the truth. He followed this in his daily life to such a degree that it became almost an obsession. It was his single rule of conduct in dealing with private or public affairs. In the latter it made him a power and a politician of the best type, by means of which he was able to do so much for medicine and medical education. Applying this rule unswervingly to himself, he was insistent that it should be followed by others, not always taking account of the weakness and frailty of humanity, and this sometimes made him appear a hard task master; but this fault, if fault it were, leaned to virtue's side, for, back of every action, its mainspring, indeed, was this intense love of the truth.

Among the tributes paid to him are the following from Dr. McCracken, Emeritus Chancellor of the University, who said:

" I first came to know Dr. Bryant well when the union of Bellevue Hospital and the University College of Medicine was first suggested. He was one of the professors named to represent Bellevue in the negotiations. He made an impression upon me at once by his broad-minded and straightforward views and methods in all business matters. He put aside in a frank, hearty spirit everything that approached narrowness or meanness. He commanded respect of all fair-minded men. Apart from his professional ability his character rendered him a powerful support of the consolidated college. He had been connected with Bellevue as a teacher for twenty-seven years before the

union, and has been a leader in the united college throughout the sixteen years of its existence.

"I found him ever genial and helpful in all university work. Since he was the most advanced in age of our professors of medicine, having entered upon his seventieth year last month, his life of public service was well rounded out. Yet to myself, both as a trustee of the university and as an individual, the removal of Dr. Joseph Decatur Bryant leaves a large vacant place."

At his funeral there was a notable gathering, the organizations represented included the New York Academy of Medicine, the New York State Medical Society, the American Surgical Association, Kane Lodge, the Medical Board of Bellevue Hospital, the Medical Board of St. Vincent's Hospital, the New York County Medical Society, the veterans of the 71st Regiment, the Faculty of New York University, and the Council of New York University. Besides these there were scores of leading medical men, delegations from the student bodies of the New York University and Bellevue Medical College, and members of the Grover Cleveland Association.

On the occasion of his funeral, Dr. Jefferson, pastor of the Broadway Tabernacle, paid this tribute to the dead physician:

"A man who serves his day and race needs no eulogy on the day of his burial. What he has done speaks so loudly that the people cannot hear what the preacher says. Such a man writes his own eulogy, day by day, and there is nothing I can add.

"He lived in this city for forty-five years, during which time he made himself well known. I am sure that those of you who knew him longest feel that you see him now better than when he was alive. Every feature of his character, his manliness, his courage, his breadth of mind, his nobility of spirit, all these stand out clear cut and beautiful."

G. D. S.

ADDRESS OF THE PRESIDENT

THE PROPHYLAXIS OF CANCER

By WILLIAM J. MAYO, M.D.
ROCHESTER, MINNESOTA

All vertebrate animals suffer from cancer in situations which are affected by their habits or conditions of life leading to local lesions in the protective mechanism. We must, therefore, look upon local lesions as an invitation to cancer without regard to just what the actual cause of cancer may be.

If parasitic agencies are the cause of cancer it would appear that their introduction into the human economy was effected through local lesions. The strongest evidence as to the parasitic nature of cancer and the best research on the problem with which I am acquainted is the work on the production of plant cancer by Edwin Smith,[1] which agrees in its main essentials with what we know about cancer as it exists in the human race.

On the other hand, if the cancerous process is one which is brought about by failure to restore normal conditions at the site of a local lesion by means of mature cells and the eventual calling forth of partially differentiated cells of an embryonic type in response to continued irritation, the role of the local lesion in either case is as important as is the actual cause.

It is probable that a large majority of human beings possess an immunity to cancer, that a lesser number possess a partial immunity, while a minority are without those protective agencies which render the local lesion ineffective. The term "precancerous," while not strictly accurate, has become allowable

through custom and graphically describes a clinical condition, as pointed out by Rodman.[2]

The clinician can say with a great deal of assurance that a certain lesion is benign, that another is malignant, but there still exists a number of mid-ground lesions of which he is unable to say that they are either benign or malignant.

The pathologist, by microscopic examination, can, in a much higher percentage of cases, definitely establish the benignity or malignancy of a growth. But, there occur certain growths which, even upon minute investigation, he will be unable to diagnose positively as benign or malignant. Sections from such growths sent to different pathologists may bring back contradictory opinions, the majority being undecided.

The microscopic picture which exists in these cases shows a change in character of the cells quite different from the normal but as yet showing no invasion of the surrounding tissues.[3] This invasion is held by most pathologists to be essential in establishing malignancy. Pathologists, however, are striving to establish criteria whereby the change in the character of the cells may be shown to indicate malignancy before invasion takes place. Such microscopic appearance is found in the periphery of malignant growths and in chronic lesions which have been known to later develop malignancy. *The term "precancerous," therefore, strictly should not be applied to all local lesions which may be followed by cancer, but only to those local lesions in which cellular changes are taking place that surpass the normal attempt at repair of the lesion itself, but which are not as yet infiltrating surrounding tissue, the local lesion acting as the invitation, the precancerous stage as its probable acceptance.*

Sites of local irritation may be divided into three general groups:

1. *Congenital* or acquired neoplasms, such as moles, warts, and benign tumors of various sorts which may undergo malignancy. Keen,[4] in 1904, called attention to the danger of degeneration of local lesions of this character and presented most interesting and instructive data in regard to their relation to

cancer. Bloodgood,[5] in recent years, in a series of remarkable papers on the cancer problem, points out that of 820 pathologically fully developed cancers of the skin and visible mucous membranes, he was unable to find a single case with a well-taken history which showed the absence of a previous defect which might be looked upon as a precancerous lesion.

2. *Trauma.* Coley[6] calls attention to the influence of trauma not only in the development of sarcoma, which has been an accepted fact for a generation, but also to the fact that trauma has a strong influence in the production of carcinoma. Coley made an analysis of 250 cases of carcinoma which came under his personal observation and the histories of which were taken by himself. There was a history of antecedent trauma in 32.8 per cent. of the cases. The influence of trauma in the production of cancer has also been pointed out by McWilliams,[7] von Bergmann,[8] Röpke,[9] Murphy,[10] Ziegler,[11] Löwenthal,[12] Liebe,[13] von Graefe,[14] and others.

3. *Chronic irritation*, whether the result of mechanical, chemical or infectious agencies, is the most important of all those precancerous conditions with which we are acquainted and it it undoubtedly the most potent influence in the development of the disease following congenital lesions and trauma. It is to be noted that cancer in any part of the body which is open to inspection may be shown, in practically every instance, to be preceded by a local lesion. The following well-attested examples may be cited: The development of cancer in the mouth from betel-nut irritation; the cancer of the groin in the chimney sweeps and sailors; the development of cancer following the chemical irritation caused by tar, paraffin, petroleum, arsenic, and aniline products; the development of cancer in local lesions produced by heat, as cancer of the lip from smoking; the "kangri" sores following burns; those cancers on the shins of locomotive drivers who have been exposed for years to the direct action of heat; cancers following chronic irritation due to different forms of radiant energy, *x*-ray, etc.; cancers following the local lesions due to infections, such as Bilharzia of the

bladder, treponema pallidum in keratosis linguæ;[15] nematodes in testicular tumors in horses[16] and in gastric cancer of rats;[17] and, rarely, the development of cancer in the glands of the neck as a result of the combined chemical and infective irritation of tuberculous cervical adenitis.[18]

A study of some particular forms of cancer which occur in great frequency as the result of a particular form of chronic irritation is most instructive. An interesting instance is the "horn-core" cancer of cattle, due to the irritation of the ropes through the horns with which the cattle pull their loads.[19] Even more extraordinary is the kangri-burn cancer either on the abdomen, thigh, or vicinity, due to the hot kangri fire-baskets which the natives of Kashmir wear on the lower abdomen under the clothing in cold weather. Neve[20] states that from 1890 to 1899, 2020 natives with tumors were operated on at the Kashmir Mission Hospital. Of these tumors, 496 were epithelial cancers, of which 363 were kangri-burn cancers. Equally striking is the betel-nut cancer of the mouth as seen in India. Neblock[21] states that of 976 carcinomas treated in the Madras General Hospital from 1892 to 1901, 411 or nearly 50 per cent. were located in the mouth. Cancer of the lip is rarely seen except in smokers. Cancer of the groin is practically confined to the chimney sweep and the sailor.

Can we doubt that if the kangri fire-basket were not worn by the natives of Kashmir that this strictly localized form of cancer would not exist? If the betel-nut were not used, the enormous preponderance of cancer of the mouth would not exist in India.

The prophylaxis of cancer on the visible portions of the body includes: The avoidance of all those habits and customs which have been shown capable of producing conditions favorable to the development of malignant disease; the removal of all congenital or acquired local lesions such as Keen and Bloodgood have shown to be prolific forerunners of malignant degeneration; and the careful observation of patients for early evidences of malignant change following trauma.

Can our knowledge of the development of external cancer be applied to the solution of the problems of the development of internal cancer? Admitting that the mass of evidence as to the rôle of chronic irritation in its various forms and types is the most important factor in the development of cancer in the parts of the body which are exposed to the eye, must we not

FIG. 1.—Case 23026G (H30188). Gross specimen, cancer of gall-bladder developing in mucosa long irritated by gall-stones. *a*, cancer; *b*, normal mucosa; *c*, area in which mucosa has been eroded by gall-stones, non-cancerous.

conclude that cancer on the inner surfaces of the body depends on the same precancerous conditions? It is difficult to develop evidence as to the early appearance of cancer on the internal mucous surfaces of the body because in the early stage there are, as a rule, no manifestations which lead to a visual examination. Yet we have seen a very considerable number of such

early cases and we have observed no instances of early cancer in the mucous membrane of the inner surfaces of the body which did not show the presence of a previous local lesion.

In nearly all the cases of cancer of the gall-bladder which we have had an opportunity to examine carefully, gall-stones were either present or there was evidence to show that they had been present (Fig. 1).[22]

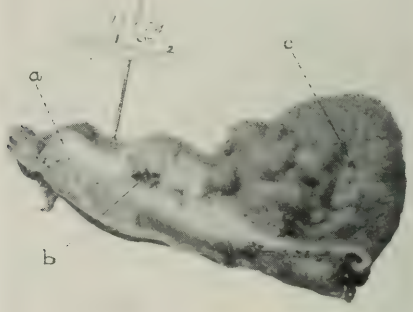

FIG. 2.—Case 5705G (H16824). Gross section through cancer of the pylorus; one of the very few cases in our series which did not show evidence of ulcer. *a*, pylorus; *b*, cancer; *c*, normal gastric mucosa.

One is impressed with the collateral evidence that the incident of gall-stones and cancer of the gall-bladder shows the same increased frequency in the female over the male. Can we doubt that early removal of gall-stones might prevent cancer of the gall-bladder? The mortality of an early operation for gall-stones, other things being equal, is less than $\frac{1}{2}$ per cent. Cancer of the gall-bladder occurred in nearly 3 per cent. of all the cases of cholelithiasis which came to operation in our clinic. We have had no permanent cures after cholecystectomy for cancer of the gall-bladder which had been diagnosed as

cancer previous to operation. A number of cures have followed the removal of early cancer incidental to the removal of thick walled functionless gall-bladders, thus showing that it is not the nature or situation of the malignant process but the delay in diagnosis which is so fatal.

Cancer of the stomach forms nearly one-third of all the cancers of the human body. So far as I know this is not true of the lower animals, nor of uncivilized man. Trustworthy

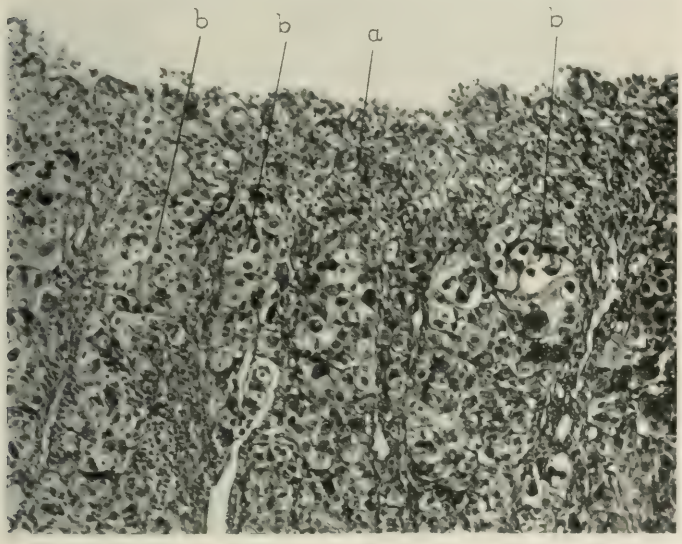

FIG. 3.—Case 80107. Microscopic section through base of ulcerated portion of gastric cancer. *a*, granulation tissue; *b*, cancer cells. In this specimen there is no pathologic evidence of ulcer preceding the cancer.

evidence on this point is for obvious reasons difficult to obtain. Why is there this extraordinary frequency of cancer of the stomach? Is the stomach a trap and the cancer parasite, if it be a parasite, strained out in the stomach? If that were true, why should not cancer of the stomach be as frequent in the lower animals as in man? In rats, cancer of the stomach is exceedingly common when the animals feed on cockroaches infested with nematodes, which cause a chronic irritation of

the rat's gastric mucosa.[17] Under other conditions it is very rare in these animals.

Whenever cancer is found with great frequency in certain situations or in only one class of individuals, it appears to depend on a single cause; this is probably true of gastric cancer. Is it not possible, therefore, that there is something in the habits of civilized man, in the cooking or other preparation of

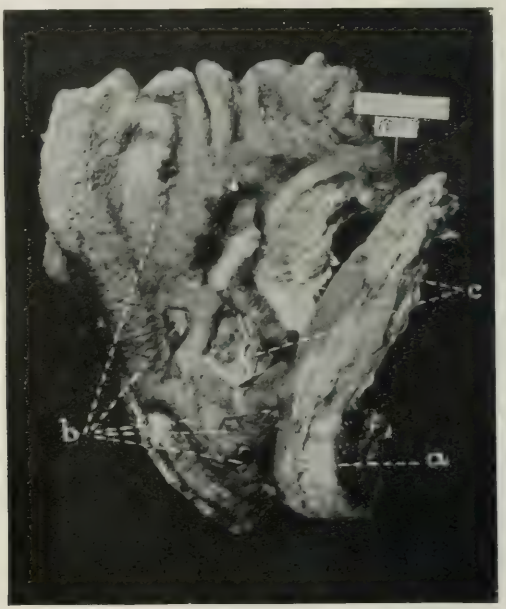

FIG. 4.—Case 6838G (H18088). Pyloric portion of stomach with multiple ulcers, two of which show areas of cancer within their borders. *a*, pylorus; *b*, chronic ulcers; *c*, ulcers with cancer developing thereon.

his food, which acts to produce the precancerous lesion? And it is probable that there is just one cause since, if there were many causes, gastric cancer in man would have no such preponderance. Numerous factors would cause the development of cancer in other races and species equally exposed to their action. If we could but know what peculiar agency was responsible for the extraordinary frequency of cancer of the stomach, the knowledge would play a great part in the prophylaxis of cancer.

Has the question of the acidity of the stomach anything to do with the problem? The frequency of cancer in the stomach and in the large intestine, where the secretions are acid, and the absence of cancer in the small intestine, where the secretions are alkaline, is a remarkable fact. Yet this acidity of the stomach is not confined to man, but, so far as I know, the extraordinary frequency of cancer of the stomach is confined to man and to civilized man. Further investigation is needed to elucidate

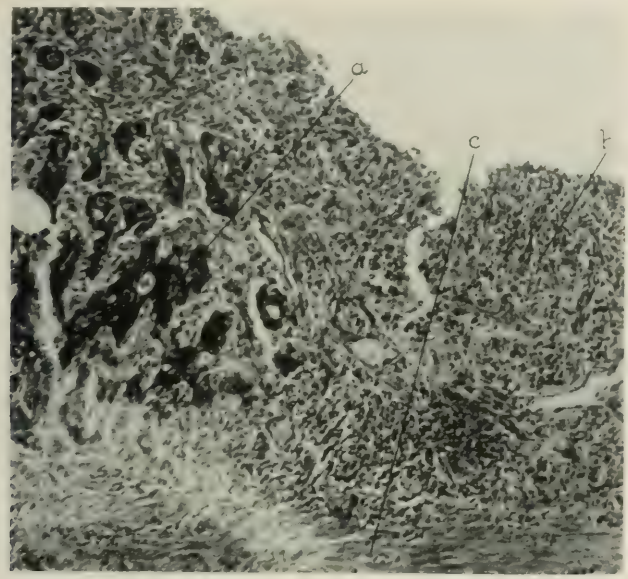

FIG. 5.—Case 77369. Microscopic section of margin of base of gastric ulcer showing cancer developing therein. *a*, granulation tissue in border of ulcer; *b*, cancer cells; *c*, scar tissue in base of ulcer. Compare with Fig. 2.

this most interesting problem and a possible source of information may lie in a comparative examination of the anatomy, physiology, and pathology and, especially, of the habits of those races of man and those lower animals in whom cancer of the stomach is rare.

Among the precancerous lesions of the stomach, ulcer is the most common. Yet it is a curious fact that ulcer of the duodenum is three times as frequent as of the stomach, though

cancer of the duodenum is rare. True it is, however, that ulcer or some other lesion in the stomach, which is of sufficient gravity to produce symptoms not necessarily of ulcer, but symptoms of chronic irritation, existed in more than half of all those cases of cancer of the stomach in which we have been able to make a resection and in a high percentage of these an ulcer was found pathologically[23] [24] (Figs. 2 and 3). Some

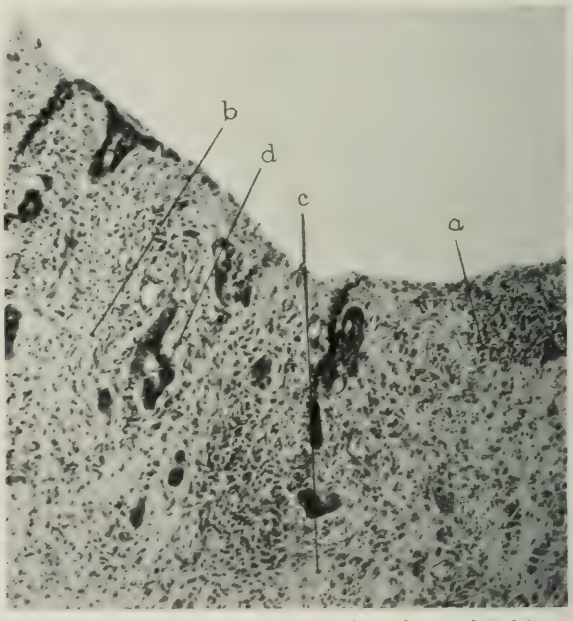

FIG. 6.—Case 1375GH. Microscopic section of margin of base of gastric ulcer showing cancer developing therein. *a*, granulation tissue in base of ulcer; *b*, scar tissue in border of ulcer; *c*, scar tissue in base of ulcer; *d*, cancer cells.

pathologists believe that these ulcers are carcinomatous from the beginning. If so, then the base of the ulcer should be carcinomatous (Fig. 4), but in our cases there was no cancer in the base of the ulcer; it was the overhanging margin of the ulcer which showed the cancer (Figs. 5 and 6). It is evident that precancerous lesions exist in the stomach and that these lesions, while possibly not always ulcer, give clinical evidence

of their presence in the precancerous stage in at least 50 per cent. of the cases in which the history is taken with this point in view. The extraordinary muscular activity of the stomach in the condition known as pylorospasm, which may result from gall-stones, duodenal ulcer, fecal stones in the appendix, or intestinal lesions, may account for the chronic gastric irritation in some cases. It is even possible that through the influence of this great muscular contraction cells may be loosened and even forced into the underlying tissue.

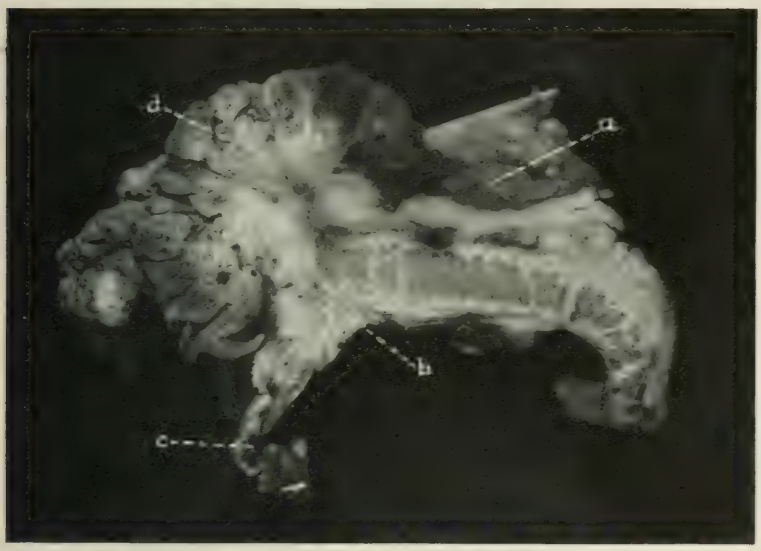

FIG. 7.—Case 61097. Gross section through pylorus showing cancer developing on a papilloma which springs from the duodenal side of the pylorus. *a*, gastric mucosa; *b*, pylorus; *c*, duodenum; *d*, cancer.

The prophylaxis of cancer of the stomach consists not only in the removal of gastric ulcers, but also in the relief of all those conditions which cause gastric irritation resulting in the symptom inadequately and possibly incorrectly described as pylorospasm.

Cancer of the small intestine is extremely rare. In a series of 1882 cancers of the gastro-intestinal canal operated on in our clinic (October 1, 1897 to November 1, 1913) only 22 were

cancers of the small intestine. Why is there this relative immunity of the small intestine over the stomach and the large intestine? The small intestines are the most primitive part of that system on which the maintenance of the body-functions depends. Is it possible that in the long heredity of this particular part it has developed an immunity? There is something fascinating about this theory as accounting for the lack

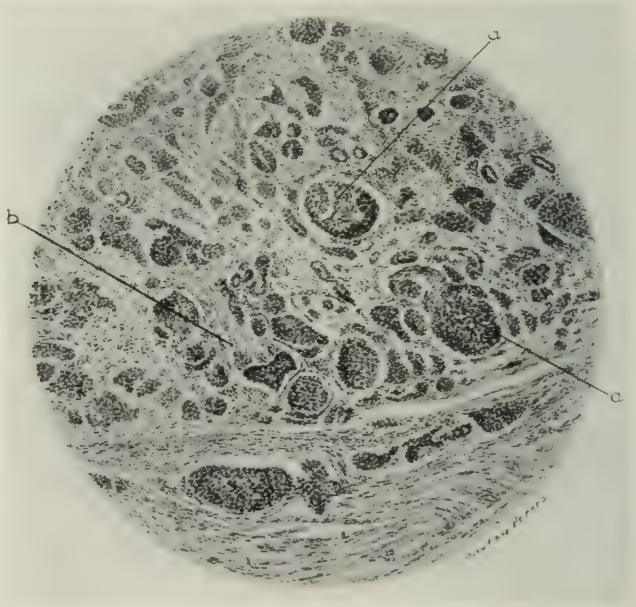

FIG. 8.—Case 25398 (H31025). Microscopic section through cancer in the tip of an appendix, the mucosa of which apparently had been obliterated by chronic inflammation. *a*, cancer cells; *b*, connective tissue.

of immunity in the stomach and the large intestine, which have relatively a short heredity. The small intestine is exceedingly primitive. That the age of any part of the body has much to do with its ability to resist disease is well known. Though it may be a figure of speech that woman was formed from the rib of man, yet it is certainly true that the ovary is descended from the testicle and that the testicle is the primitive organ found

in bisexual species.[25] Tumors of the testicle are rare. As shown by Ewing,[26] all the newgrowths of the testicle with few exceptions are teratomas, the most primitive type of neoplasm. The ovary, on account of its short heredity, is subjected to a multitude of diseases and a large variety of tumors.

FIG. 9.—Case 18633G (H28835). Gross longitudinal section through specimen removed from sigmoid showing chronic diverticulitis with cancer developing thereon. *a* and *b*, diverticula; *c*, surface of cancer.

Beard's[27] theory that the immunity of the small intestine is due to the pancreatic secretion destroying whatever malignant virus may exist therein may also be mentioned. It is interesting to note, however, that the small intestines have comparatively few sources of chronic irritation and that when malignant disease of the small intestine is found it is usually due to a pre-existing lesion, such as a degenerating polyp, adenoma, or papilloma (Fig. 7).

Cancer of the appendix usually occurs in association with chronic obliterative processes[23] (Fig. 8).

The large intestine has a much greater liability to malignant disease than the small intestine and the frequency with which cancer is found to be grafted on a source of chronic irritation can only lead to the conclusion that the soil produced by chronic irritation needs only to be activated by the cancerous

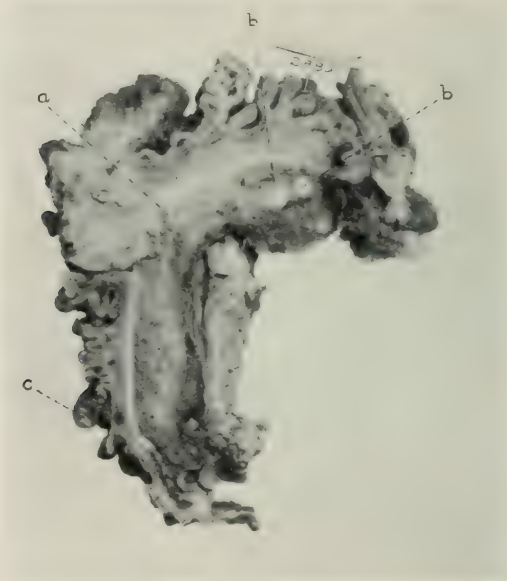

FIG. 10.—Case 18631G (H28835). Gross longitudinal section through same specimen as shown in Fig. 9 at level marked *c*, showing cancerous areas. *a*, cancerous mass surrounding almost completely obliterated diverticulum; *b*, *b*, metastatic cancer of lymph glands; *c*, normal mucosa.

virus to produce cancer in susceptible individuals. The rule is that the original lesion, by the time operation is made, has been completely obscured by the carcinomatous process, but in all our early operations lesions of a precancerous nature were found. Especially is this true of the sigmoid and rectum, where, in 37 cases of diverticulitis, the irritation of the little hard balls of fecal material in the ends of these pouches had given rise to

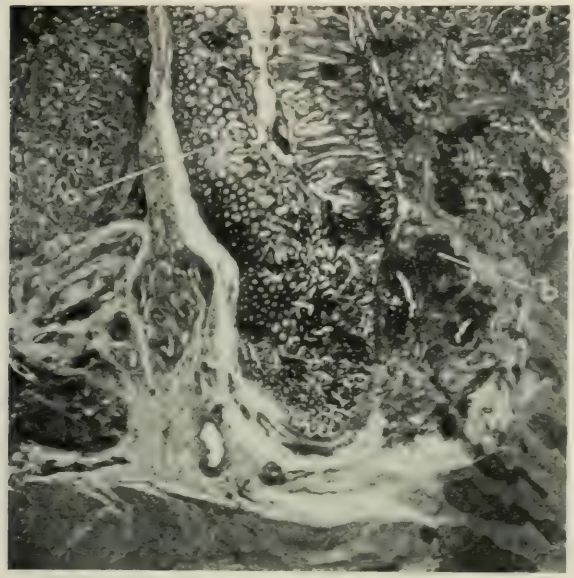

FIG. 11.—Case 9496G. Microscopic section longitudinally through a diverticulum of the sigmoid in the wall of which cancer has developed. *a*, hyperplastic mucosa; *b*, cancer.

FIG. 12.—Case 37405. Gross longitudinal section through the wall of rectum showing diverticula around which cancer has developed. *a*, *a*, diverticula; *b*, surface of cancer which, starting around the diverticula, has extended to the mucosa.

malignant disease in 20 per cent. of the total[29 30 31 32] (Figs. 9, 10, 11, and 12). It is probable that the supposed long duration of cancer of the large intestine, cases of which have been reported, were in reality tumefactions from chronic diverticulitis followed later by malignant change.

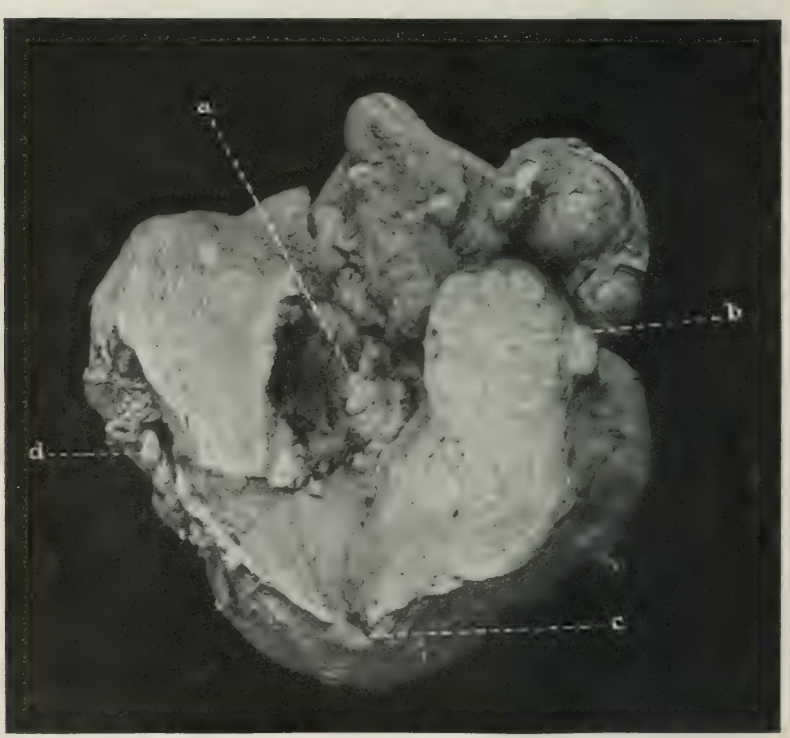

FIG. 13.—Case 46337. Uterus opened to show cancer beginning at point where endometrium has been chronically irritated by a fibroid in opposite wall of uterus. *a*, cancer; *b*, fibroid; *c*, cervix; *d*, right tube.

We must not lose sight of the fact that a changing physiology of an organ may be of itself a source of weakness and possibly act as a cause of local irritation. Such a change is undoubtedly going on in the proximal half of the large intestine. Plant life is parasitic on the inorganic world and depends on chlorophyl for its potency. We should know more about chlorophyl

upon which in the last analysis life depends. Animal life is parasitic upon plant life, man on both plant and animal and increasing rapidly the intake. Within the last 100 years, four times as much meat is taken as before that time.[33] If flesh foods are not fully broken up, decomposition results and active

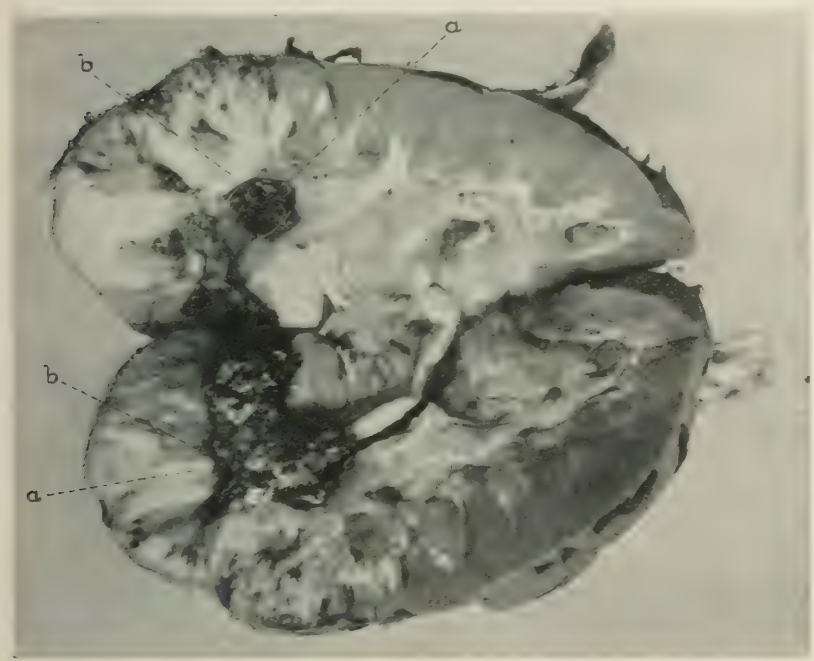

FIG. 14.—Case 83255. Gross section through kidney showing cancer developing in tissue chronically irritated by stones. *a*, *a*, stones; *b*, *b*, cancerous areas.

poisons are thrown into an organ not intended for their reception and which has not had time to adapt itself to the new function.

The development of malignant disease in the uterus and kidney shows the same relation to chronic irritation. Cancer of the cervix occurs fifteen times as frequently as cancer of the body of the uterus, but in myomatous disease cancer of the body of the uterus is found five times as frequently as cancer

of the cervix, the chronic irritation of the uterine tumors increasing the incidence 75 times (Fig. 13).

Of all the cases of epithelial cancer of the kidney which came to operation in our clinic not less than 50 per cent. were demonstrably superimposed on extensive renal calculus formation (Figs. 14 and 15).

FIG. 15.—Case 30265. *A*, gross section through kidney removed at operation, showing cancer developing in tissue chronically irritated by large stones; *a*, *a*, stones; *b*, *b*, cancerous tissue; *B*, metastatic cancer in liver of same case (autopsy); *C*, metastatic cancer in wall of intestines from the same case (autopsy).

In conclusion, I would again call attention to the fact that pre-existing lesions play the most important part of the known factors which surround the development of cancer, that such precancerous lesions are produced by some habit or life condition which causes chronic irritation, that where cancer in the human is frequent a close study of the habits of civilized man as contrasted with primitive races and lower

animals, where similar lesions are conspicuously rare, may be of value, and finally, that the prophylaxis of cancer depends, first, on a change in those cancer-producing habits and, second, on the early removal of all precancerous lesions and sources of chronic irritation.

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THE TWO-STAGE OPERATION, ESPECIALLY IN ITS RELATION TO TREATMENT OF CANCER

By GEORGE W. CRILE, M.D.
CLEVELAND, OHIO

Both the immediate and the remote results of certain operations are improved if these operations be performed in two stages, *partly because the patients may be too much weakened to endure at one blow the stress of the entire operation and the subsequent physiological adjustment; partly because one stage may prepare the way for a safer second stage;* and in part that the immediate reimplantation of cancer cells may be prevented. This paper considers cases in the latter class and deals specially with operations for cancer of the rectum, of the stomach, of the large intestine, of the uterus, of the larynx, and of the tongue, with a short discussion also of the value of the two-stage operation in abdominal infections and in exophthalmic goitre. The objection to the two-stage operation in the past has been the reluctance of the patient to endure the ether distress a second time, but if the operation be performed under anoci-association, with nitrous-oxide-oxygen anesthesia, then the experience of the *anociated* patient in the first stage of the operation is so much easier than his anticipations—his loss of vitality and change of nervous threshold are so slight—that he is emboldened to meet the second stage with equanimity. It has been gratifying to find that the second—usually the major stage—causes no more disturbance, sometimes less even, than followed the preliminary operation. For example, it has been our experience that in the first of the two stages of a laryngectomy the variations of pulse and temperature were more marked than in the second stage.

Cancer of the Rectum. In cancer of the rectum, the preliminary colostomy prepares the way splendidly for the major operation. In this operation the energy of the patient is so conserved, and he passes through the first stage so easily that he undergoes the second stage without reluctance, while the establishment of the artificial anus in advance of the major dissection makes possible the maintenance of a far less infected wound. My associate, Dr. Lower, and I have performed sixteen operations on this plan without a fatality.

Cancer of the Stomach. In cancer of the stomach, gastro-enterostomy is performed at the first operation, the resection being performed as soon as the nutritional balance is assured—usually within ten days or two weeks. In starved cases of gastric ulcer Professor von Eiselsberg's method is excellent. A jejunostomy is first performed under local anesthesia, the final operation being delayed until a safe margin of vitality has been attained by feeding. Gastro-enterostomy alone gives a rather high light morbidity as compared to gastrectomy, as in the former the wound is not as extensive as in the latter operation, and the physiologic and anatomic readjustment is more readily made. This readjustment being accomplished, the gastric resection is performed with a wider margin of safety. By dividing the trauma and relieving the patient from the burden of extensive wound recovery simultaneously with the physiologic adjustment, the risk is decidedly less than if one massive chance had been taken.

An unexpected advantage in the two-stage operation for gastrectomy is illustrated in a recent case. A large pyloric mass was diagnosed as cancer and at the preliminary operation even was believed to be cancer. At the second operation, which on account of the extreme emaciation and weakness of the patient, was delayed for an unusually long time, it was found that the large solid mass at the pylorus had disappeared as if by magic. To make certain that no cancer existed at its base, the former ulcer was resected—a simple, almost a minor operation. No histological evidence of cancer was found. Had the

entire operation been performed at one time, not only would a needless operation have been performed but the patient's life would have been seriously jeopardized.

Cancer of the Uterus. In a dissection operation the greatest danger is that of immediate reimplantation of cancer cells in the operative field. Hence, if the operation is to be performed by the cutting method, extensive destruction by the cautery is a safe preventative of reimplantation.

In *cancer of the cervix*, at the first operation every vestige of the growth is destroyed by heavy cautery irons which carry enough heat to make a penetrating coagulation of protoplasm —*coagulation, not eschar*, is the aim. After the local cancerous growth is destroyed the vaginocervical attachments are severed with a dissecting cautery, in order that all bloodvessels running from the vagina to the uterus may be divided. The resultant anemia will destroy all the detached cancer cells within one day, after which abdominal hysterectomy is performed—without danger of immediate cancer implantation.

In this, as in all two-stage operations, the use of nitrous-oxide-oxygen plays a most benevolent role. The patient has no distressing experience in going under this anesthetic and therefore anticipates the larger operation without fear.

Cancer of the Larynx. At the first stage the deep planes of the neck on each side of the trachea are packed with iodoform gauze. This causes a local reaction which fixes the trachea, and protects the mediastinum. This technique eliminates the great danger of mediastinal infection which, after pneumonia, has caused the greatest number of deaths.

The danger of vagitis also may be eliminated if the dissection is carried on one side of the larynx all the way to the upper margin of the field of final operation, this territory being packed with iodoform gauze just as the deep planes of the neck are packed. By this procedure one vagus must take the brunt of exposure and adjustment before the larynx is removed. By the time the laryngectomy is done this vagus will be readjusted and ready to resume its function.

The second stage—the excision of the larynx—is safely and easily accomplished. Of thirty-four laryngectomies twenty-eight have been performed in two stages with but a single death.

Cancer of the Tongue. In operations for cancer of the tongue two difficult problems must be met, the immediate surgical risk and the possibility of permanent cure. The principal immediate danger is pneumonia from inhalation of infection from the field of operation, while there is also danger from the exhaustion which is a result of the diminished ingestion of food and the prolonged endurance of the disease.

To ensure a permanent cure not only is the cancer to be removed but all the glands of the neck must be completely excised whether they be enlarged or not. If both of these operations be performed at the same seance, then the patient may go to the ground because he is unable to bear the burden of the diminished nutrition, the soreness over so large a field as the mouth and neck, and the inevitable infection in the mouth. The possibility of a permanent cure depends also on the prevention of the immediate reimplantation of cancer cells in the mouth at the time of the operation. If the cancer is not large, no cutting operation whatever is made, but with the cautery all of the disease in the mouth is destroyed. If, however, the growth be extensive, it is best on one day to cauterize the field of the disease and on the following day, after the diseased cells have died of starvation, to excise the entire cancer field in the mouth. After the patient has well recovered from the mouth operation and is able to take nourishment satisfactorily, the final operation—the excision of the glands of the neck—can be performed without great inconvenience to the patient.

In addition to the lessened risk of the extension of the cancer, the two-stage operation lessens the danger of infection of the neck field also, for when the whole operation is performed at one seance the neck is so sore that the patient is almost certain to inhale infection from the mouth directly; whereas if the neck be normal, the patient is able to stand up, to move

about, to spit out the inhalations, and thus to protect his lungs against infection.

Acute Abdominal Infections. In cases of *acute pelvic abscess* resulting from a specific infection, a vaginal puncture, followed by partial resolution, with an abatement of the acute symptoms, leaves an immensely improved risk for a second operation should it be required by a remaining chronic salpingitis.

In *acute appendicitis with a strongly walled off abscess* the appendix is removed if it can be readily picked up; if not, a simple drainage is first made, the appendix being removed after the wound is entirely cleaned and healed. The cautious entry and the opportune exit under anoci-association technique and nitrous-oxide-oxygen anesthesia leaves the patient's phagocytic defenses normally good instead of anesthetized by the lipoid-solvent ether. Operation is always on admission. Under anoci technique we are able to show a series of 208 operations for acute appendicitis without a single death; the average change of pulse during the operation being a *fall* of 2.8 beats.

In *critical cases of acute cholecystitis* a similar program is followed. Unless an easy total excision is possible a simple drainage only is first made—stones are not even searched for. The cholecystectomy is deferred until the acute storm has passed and the margin of safety has been established.

In *obstruction of the bowels from cancer*—a feather-edge colostomy serves as a safety valve until the margin of safety has widened, when the excision is performed.

In *gangrene with heavy intoxication the gangrenous loop* is carried outside the body and drained. *If* and *when* a margin of safety is gained an anastomosis is made.

Exophthalmic Goitre. In exophthalmic goitre a *two-* or even a *three-stage* operation may play the patient's game more safely. The first operation is the most dangerous, but since hyperthyroidism can be controlled through anoci-association and morphinization, we now have to fear acidosis only. Acidosis may be precipitated by psychic excitation, by physical

injury, or by a too sudden diminution of thyroid tissue. For this reason I now perform the preliminary ligation in bed under complete anoci-association. This we can now do in most cases without causing more reaction than is caused by the excitement of entering the hospital. In some cases there is less reaction in the patient than in the patient's relatives. In a series of 74 exophthalmic goitre cases operated upon under anoci-association the pulse rate was especially noted and the average change during the operation was a *fall* of 5.5 beats.

SUMMARY. 1. The newer developments in surgical technique, by which most of the danger and most of the suffering and discomfort even of surgical operations has been eliminated, have enabled the surgeon to fully utilize the advantages of two-stage operations for cases heavily handicapped by lowered vitality, while in cancer cases the danger of immediate reimplantation is minimized.

2. Critical cases of acute infections of the pelvis, of the appendix, or of the gall-bladder, may be more safely treated by a preliminary drainage, the operation being completed after the margin of safety has widened.

3. If we adjust the operation to the patient rather than the patient to the operation, I believe that we shall greatly reduce the mortality rate which now accompanies the surgical treatment for cancer of the stomach, intestines, larynx, and tongue, and

4. That we shall reduce the mortality which attends acute abdominal infections and of certain cases of intestinal obstruction.

5. The technique of anoci-association greatly expands the strategic possibilities of opportune surgery and lessens the mortality and morbidity attending critical operations upon heavily handicapped patients.

DISCUSSION

Dr. Fred B. Lund, Boston.

I have employed the two-stage operation in ulcer and cancer of the stomach only in cases where the patient was very weak, because I have found that the two-stage operation, while it has certain advantages, also has certain disadvantages. If at the first operation you perform gastro-enterostomy some distance from the cancer of the stomach, and three weeks later (perhaps I waited too long), find the cancer has progressed so close to that opening that you have to go uncomfortably close or tear away your gastro-enterostomy sutures and make a new one, you are liable to agree to the disadvantages. I have also found at the second operation that a large malignant looking tumor had become absorbed, making the second stage exploratory only. In cases where there is doubt of the diagnosis of cancer I would be more inclined to it than in cases where I was sure of cancer, because not only may cancer progress during the waiting stage but it may be more extensive when you come to take it out, and the adhesions resulting from the previous gastro-enterostomy may hamper a thorough operation at the second stage. In cases where resection is easy, the patient in good condition, I should never think of two-stages in undoubted cancer of the stomach.

In regard to cholecystectomy during acute cholecystitis, we do more and more of them with complete convalescence, and I do not believe one often needs a two-stage operation in this condition. I presume the anoci-association may make a difference in the way with which patients submit to operations, but patients in our part of the country are glad to get through in one.

Dr. James E. Moore, Minneapolis.

I have for a long time been a firm advocate of the two-stage operation in selected cases. I know of no more satisfactory procedure than this with an enlarged prostate and infected bladder where ether anesthesia would be fatal, under a local anesthetic to make a small incision suprapubically and drain the bladder. I am also in accord with the suggestion made by Dr. Crile in reference to appendectomies. There is a strong tendency to undertake too much and interfere with some of the undertakings of the Almighty. Many times have I opened a large abscess and not been able to find the appendix without ripping things up, and have left it, had my patient recover, and then did a second operation followed again by recovery.

Dr. Howard Lilienthal, New York.

It is now five years since I read a paper on this subject and published it in the *Annals of Surgery* for 1910, and in that paper I emphasized what I thought was the importance of the two-stage operation in resection of the pylorus. Since then I have come to the conclusion that the method is even more valuable than I thought at first and I now perform nearly all my pylorectomies in this manner. I believe that it is of particular importance in the ulcer cases because here the interval between the first and second step permits inflammatory enlargements to disappear.

I trust that Dr. Lund will advise his patient to submit to a secondary pylorectomy.

A number of years ago I undertook a two-stage pylorectomy in which a large tumor the size of a duck's egg which was present at the first operation disappeared completely at the end of two weeks. The second operation was therefore merely exploratory and the patient returned with a tumor some years afterward which showed borderline changes.

By making the gastro-enterostomy far from the pylorus and by exercising the greatest gentleness in handling the pyloric region, by omitting the use of gauze or other irritants in that region, there will be few or no adhesions at the time of the second operation.

In a few days I expect to perform the second stage in a case in which there was a nodule at the pylorus at the first operation three weeks ago. It is my intention to remove this pylorus whether or not it shows disease.

I have thus far operated by the two-stage method in 11 cases and I am more than ever convinced of the wisdom of the procedure. No patient has refused the second operation.

Dr. Arpad G. Gerster, New York.

There is no doubt that the two-stage operation where indicated by special conditions is a very useful expedient, but the argument advanced by Dr. Moore, that in appendicitis where doing too much is interfering with the designs of the Lord, might be applied to all surgery, which is all an interference with the designs of the Lord. Another point is this: Dr. Crile has shown us some points of great practical value aside from the extreme interest that is in the theories upon which his arguments are based, but there is a great difference in doing a two-stage operation where necessary and in doing it under all circumstances. I believe that the broad application of this principle as a routine is entirely unnecessary. If we put ourselves in the situation of the patient, we can sympathize with those who object to

being anesthetized the second time. If I ever have to be operated on, I will be willing to run a little additional risk in order to get through at one clip. There is no doubt about it, that an extended experience in surgery demonstrates that in a great many cases, the majority of all major cases, the two-stage operation is unnecessary. For instance, appendicitis has already been mentioned, gall-stone surgery, and I would not exclude stomach surgery, as well as many other branches, where the practical experience shows it is not necessary. We ought to be humane and diminish the anguish and moral suffering to which the patient is subjected during the performance of an unnecessary operation. If the preparation and after-treatment are carried out intelligently the patient's suffering is diminished to a minimum far below what was considered unavoidable thirty years ago. Therefore I think, although the method is useful when employed in selected cases, yet to make it routine is certainly unnecessary and would hamper the hospital surgeon to a tremendous extent, especially where ten or fifteen patients have to be operated on in three to four hours.

Dr. Frederic Kammerer, New York.

Inflammatory infiltrations about ulcers near the pylorus occasionally entirely disappear in a number of weeks after gastro-enterostomy. I have reopened the abdomen in 2 cases of this kind, only to find that the suspected malignant tumor had disappeared. All tumors of this class will be favorably influenced by gastro-enterostomy, although perhaps not to the extent of their total disappearance at the second stage of a two-stage operation. In malignant tumors of the pylorus, it has seemed to me that the effect of a preliminary gastro-enterostomy in this direction is decidedly less than in malignant tumors of the lower intestinal tract, notably the rectum, where a deflection of the fecal current is generally followed by a marked decrease in size of the growth and an increase in its mobility, greatly facilitating a later resection. There is, however, another drawback to the two-stage operation in pyloric tumors, viz., the site of the anastomosis. The opening in the stomach should be placed as near as possible to the line of section of the stomach, and it has been my experience that the adhesions, which necessarily form around a posterior gastro-enterostomy, have considerably increased the difficulties of secondary resection in the two-stage operation, when this point is kept in mind.

Dr. Alexander Primrose, Toronto.

Dr. Crile has shown that the two-stage operation has a very valuable application. It should undoubtedly be the method of procedure in

many cases, yet I quite agree with Dr. Gerster that it should not be considered a routine measure. Dr. Crile, for example, spoke of the value of the drainage of loops of gangrenous bowel as a primary procedure to be followed by a secondary operation of resection, etc. I would take issue with him if he wishes to advocate that as a routine method of treatment. As an illustration of my position I would refer to a case of volvulus high up in the small bowel, where the upper end of the gangrenous loop was within some twelve inches of the duodeno-jejunal juncture; excision of the gangrenous portion of the bowel was made and drainage by means of Paul's tubes instituted; no further operation was done as the patient's condition would not permit it. We had in this case the great difficulty of maintaining nutrition. The portion of bowel severed was so close to the duodeno-jejunal juncture that little or no opportunity was left for absorption of digested material passed on from the stomach and duodenum. We tried to guide the material from the upper segment of bowel into the lower, and we attempted to feed by injecting predigested stuff into the lower segment and per rectum. In spite of our efforts she became emaciated. We were compelled to perform a second operation in twelve days as she was losing ground rapidly. The adhesions were such that the operation was exceedingly difficult; in addition septic conditions were necessarily present and the patient succumbed. My object in referring to this case is to point out that we might possibly have saved this life had we been able to perform an immediate operation of anastomosis. In contrast with this experience I may cite another case of volvulus of the small bowel occurring at a lower point in the intestine and which proves the value of such an immediate operation where it is possible to carry it out. In this case the loop of bowel was gangrenous a few inches above the ileocecal valve; the loop was resected and immediate anastomosis performed; the patient made an excellent recovery. Her chances of recovery would not have been so good had we drained the bowel as a primary operation.

I would also take issue in acute appendicitis. I think the gangrenous and septic appendix is a great source of danger in these cases and should be removed if it is at all possible to do so. My experience has been that if the appendix is left you not only have trouble locally, but also a great danger of spreading infection along the lymphatic channels, with for example, a resulting subphrenic abscess. This is a much more common sequel when the appendix is left and the abscess drained. In the search for the appendix in these cases I have had the experience of opening unexpectedly a second pocket of pus which would have remained unopened had I not instituted

the search. I think the removal of the appendix in acute cases, if it can be done without too great damage to the tissues, should be carried out as a routine measure.

Dr. George W. Crile, Cleveland (in closing):

Of course I do not propose the two-stage operation for every case, but especially for the grave risks which I mentioned at the beginning of my paper. The discussion resolves itself into two questions: What shall we do with the acute infections? And how shall we operate in cases of carcinoma? It does not matter what the theory may be, the one and only aim is to cure the greatest number of cases with the least amount of suffering to the patients. The only way to determine whether it is best to break down the walls of adhesions about a circumscribed abscess in a case of acute appendicitis is to make a long series of observations.

In the last 258 cases of acute appendicitis, I operated on every case on admission. About 5 per cent. of these operations were done in two stages and among them there were but two deaths.

As to cancer, we want to remember that pylorectomy for cancer, even in the hands of the most skilful surgeons, has a mortality rate of at least 10 per cent. When a surgeon must offer to his patient but one chance in ten of escaping death, and but a feeble chance of getting rid of his disease, the patient must play against pretty heavy odds.

Cancer of the rectum has the tremendous mortality of 20 per cent. We ought to reduce our mortality rate for these cases far below what it is today. We should not be satisfied until we reduce the mortality rate for resection of the stomach to 2 per cent. and of the rectum to 3 per cent.

SOME PROBLEMS IN THE EARLY DIAGNOSIS AND TREATMENT OF SARCOMA OF THE LONG BONES

By WILLIAM B. COLEY, M.D.
NEW YORK CITY

For many years I have been specially interested in the study of sarcoma of the long bones, and have given considerable attention to the question of early diagnosis. Although much has been written on the subject during the last few years, there are still many important points unsettled which must await the fuller knowledge derived from larger experience and more complete data.

By far the most illuminating discussion of this subject was that before the Royal Society of Medicine in London, November, 1912. To this discussion, Sir Alfred Pearce Gould, Sir Bland Sutton, Sir Frederick Eve, Mr. G. H. Makins, and several other surgeons and pathologists of note contributed the results of their large experience and broad knowledge. In addition most important new data were presented by Mr. G. E. Gask and Mr. R. C. Maybury.

Mr. Gask reported the results of the treatment of sarcoma of the long bones observed at St. Bartholomew's Hospital from 1902 to 1911, a total of 61 cases, in carefully tabulated form; and Mr. Maybury gave a statistical report of long-bone sarcoma cases at St. Thomas' Hospital from 1901 to 1911—45 in all.

The distribution of the St. Bartholomew cases is as follows:

	Male.	Female.	Total.
Clavicle	0	2	2
Femur	18	7	25
Fibula	1	0	1
Humerus	7	1	8
Radius	2	0	2
Scapula	7	2	9
Tibia	10	4	14
Ulna	0	0	0

I can call attention only in the briefest way to the results. Of the femur cases, 25 in number, not a single patient with periosteal sarcoma was alive over three years after operation, and only one remained well eighteen months after. Of the myeloid, 4 in number, 2 remained well over three years. Of the humerus cases, 8 in number, all were reported dead, not a single one reaching the three-year limit. Of the 2 radius cases, 1 died and 1 remained well over three years. The scapula cases are included in this list, although it seems to me hardly proper to do so; of these, 8 in all, 1 was well over three years and the remainder had died. Of the tibia cases, periosteal type, 11 in number, 1 was well over five years, and of the myeloid type, 3, one remained well over three years. In other words, of a total of 61 cases, only 5 passed the three-year limit, that is, 2 myeloid cases of the femur, 1 radius, and 2 tibia.

As regards the St. Thomas' Hospital statistics, there were 28 periosteal cases, and 17 myeloid. Of the former, 11 were not traced, 14 had died, 1 was well two years after operation, and not a single case passed the three-year limit. Of the 17 myeloid cases, without regard to the particular bone in which the disease originated, 8 were not traced, and of the remaining 9, 2 died and 5 remained well over three years. The latter 5 cases were all of the giant-celled type and were located as follows: 1 femur, giant-celled, well nine years after amputation of the thigh; 1 femur, giant-celled, well seven and one-half years after amputation of the thigh; 1 femur, giant-celled, well three and one-fourth years after amputation of the thigh; 1 femur, myeloid, well three years after operation; 1 tibia, giant-celled, well six years after operation.

It is further worthy of note that not a single humerus case was cured by amputation. Apparently resection had not been employed in either hospital even for the giant-celled or myeloid type. Grouping the statistics of the two hospitals together, of the 106 cases treated in both only 10 had passed the three-year limit.

SYNOPSIS OF TABLES, 1902–1911.

St. Bartholomew Hospital Cases.

Type.		Well over three years.
Clavicle	2	0
Femur (periosteal)	21	0
Femur (myeloid)	5	3
Humerus (periosteal)	8	0
Radius (myeloid)	2	1
Scapula (periosteal)	9	1
Tibia (periosteal)	11	1
Tibia (myeloid)	3	1

Butlin's Collected Cases.

Type.		Well over three years.
Clavicle	7	0
Femur (periosteal)	68	1
Femur (myeloid)	46	5
Radius and ulna (myeloid)	16	6
Radius and ulna (periosteal)	25	1
Radius and ulna (periosteal)	35	1
Radius and ulna (myeloid)	52	9

The study of these interesting groups of cases treated at two of the leading hospitals in England show that, with all the aids in recent years, for reaching an early diagnosis, the prognosis is but little improved over the gloomy statistics of Butlin a generation ago, the prognosis in periosteal sarcoma being practically hopeless in both series.

In conjunction with these cases, I would submit a brief analysis of my own cases, the results of which are considerably better than those quoted above. This fact I am certain is not due to earlier diagnosis, as many of the cases were far advanced and inoperable when they were referred to me; but I believe the cause of the improvement must be looked for in the difference in the methods of treatment. This difference has consisted in the use of the mixed toxins of erysipelas and Bacillus prodigiosus in a certain number of cases before amputation, in the hope of saving the limb, and in other cases immediately after amputation in the hope of preventing a recurrence.

Personal Cases:

Femur	60
Tibia	20
Fibula	5
Humerus	20
Radius	6
Ulna	4
Clavicle	6
Metacarpal	2
Metatarsal	1
Total	124

A Résumé of Final Results. Inasmuch as my cases have been published more or less in detail in previous papers,[1] I shall at present give only a brief résumé of the successful cases.

Case I.—Spindle-celled sarcoma of the tibia; periosteal. W. F., male, aged twenty-seven years; amputation had been advised. Entire disappearance of the tumor under four months' treatment with the mixed toxins. Patient in good health today, sixteen years later with perfectly normal limb. He was presented before the International Congress of Surgeons, at the General Memorial Hospital, on April 10, 1914.

Case II.—Periosteal round-celled sarcoma of the femur, involving two-thirds of the shaft; extensive metastases in the pectoral region. A. G., male, aged nineteen years. Hip-joint amputation had been advised, but refused by the patient. Entire disappearance of the disease under two months' toxin treatment. The patient remained well for ten years, when he developed a highly malignant tumor—sarcoma and epithelioma—at the site of an old *x*-ray burn in the skin of the thigh, which proved rapidly fatal. (This case was reported fully in *Annals of Surgery*, July, 1913; Trans. Amer. Surg. Assoc., 1913.)

Case III.—R. L., female, aged eighteen years. Central sarcoma of the upper end of the femur; round-celled and giant-celled; spontaneous fracture; too far advanced for hip-joint amputation. Recovery under the mixed toxins treatment; patient in good health, with sound limb, eight years later.

Case IV.—A. C., female, aged thirty-one years. Sarcoma of the humerus, upper end, round-celled, central, with involvement of glenoid cavity. Too far advanced for shoulder-joint amputation. Incomplete operation, curetting, followed by prolonged toxin treatment, carried out by Dr. J. B. Blake, of Boston, under my direction. Patient well fourteen years later.

[1] Sarcoma of the Long Bones, with Report of 68 Cases, Annals of Surgery, March, 1907; A Plea for More Conservative Treatment of Sarcoma of the Long Bones, Jour. Amer. Med. Assoc., January 29, 1910; Le Traitément Conservateur du Sarcome des os Longs, Extrait des Comptes Rendus du 24" Congres de l'Assn. Française de Chir., 1911.

Case V.—K. K., female, aged seventeen years. Sarcoma of the tibia, central, involving periosteum. Rapid recurrence had followed three conservative operations. Under six months' treatment with the mixed toxins, combined with a short period of *x*-ray treatment, the patient entirely recovered without loss of leg. She is in good health at present, nine years later. She was shown by me at the General Memorial Hospital, before the International Congress of Surgery, April 10, 1914.

Case VI.—Male, aged fifty-eight years. (Dr. Williamson's case.) Periosteal round-celled sarcoma of the femur, considered too far advanced for hip-joint amputation by Dr. William J. Mayo, of Rochester, Minnesota, who advised the mixed toxin treatment, which was carried out by Dr. Williamson, of Grand Forks, North Dakota, under my direction. Entire disappearance; limb saved; patient perfectly well at present, five years later. Microscopic examination made at the State Laboratory of North Dakota.

Case VII.—J. P. W., male, aged thirty-five years. Sarcoma of femur, central, not giant-celled, involving periosteum. Amputation below trochanter by Dr. John L. Erdman. Toxins given for four months after operation. Patient well at present, nine years later.

Case VIII.—S. D., female, aged eighteen years. Sarcoma of the lower end of the femur, mixed-celled involving periosteum. Amputation below trochanter, followed by five months' toxin treatment. Patient in good health when last observed, six years later.

Case IX.—L. M. L., female, aged thirty-one years. Sarcoma of radius, periosteal, pathological fracture; amputation; toxins for three months after operation; well at present, six years later.

Case X.—M. F., female, aged twenty-six years. Sarcoma of radius, central origin, giant-celled; pathologic fracture, amputation advised by two surgeons; refused by patient; curettage followed by toxins for six months; disappearance of tumor; patient well at present, six years later.

Case XI.—C. L., female, aged thirteen years. Sarcoma of femur, periosteal; toxins for four months after operation; patient remained well for three years, then developed pulmonary metastases, causing death six months later.

Case XII.—F. S., female, aged twenty-five years. Sarcoma of the lower end of the radius, round-celled; rapid growth; pathologic fracture; curettage; followed by toxins for six weeks. Entire disappearance of the tumor; patient well when last heard from, two years later.

Case XIII.—Sarcoma of femur; central origin, mixed-, round- and spindle-celled, involving entire lower end of femur. Amputation; toxins for nearly a year after amputation; patient in good health at present, nearly six years later.

Case XIV.—I., male, aged fifteen years. (Case of Dr. Robert W. Lovett, of Boston.) Sarcoma of ulna, round-celled, toxins given for four months after amputation of arm; patient in good health four years later.

Case XV.—(Case of Dr. Willmouth, of Louisville, Kentucky.) Sarcoma of femur, round-celled, periosteal; toxins before amputation. Almost complete disappearance of tumor; restoration of health; patient well when last observed, 18 months after treatment, which was carried out by Dr. Willmuth, under my direction.

Case XVI.—Sarcoma of clavicle, round-celled, periosteal; very rapid growth. Total excision of clavicle, followed by toxins for four months; patient remained well five years.

Case XVII.—Sarcoma of clavicle, round-celled, periosteal; total excision; toxins given for a period of eight months. Patient well at present, six years later.

Case XVIII.—R. G. H., male, aged forty-six years. Sarcoma of humerus, periosteal, round-celled; metastatic, after amputation of leg for tibial sarcoma. Amputation of shoulder-joint by Dr. Brackett, of Boston, followed by toxin treatment for four months. He remained well for nearly three years; then developed metastases in the spine, for which a laminectomy was done, which he did not survive.

Case XIX.—F. K., female, aged sixteen years. Sarcoma of the metatarsal bone, periosteal, small, round-celled, of rapid growth. Amputation of lower third of leg. Toxins for six months. Patient well when last heard from ten years later.

Case XX.—C. M., male, aged thirty-five years. Sarcoma of femur, periosteal, round-celled; involving upper third of shaft of leg; rapid growth. Toxins given for four months, and while the growth was checked the tumor did not disappear. Amputation at the hip-joint later performed by another surgeon. Patient well when last heard from one and one-half years after amputation.

Case XXI.—A. J. McC., male, aged forty-one years. Sarcoma of lower end of femur, round-celled, of central origin, involving the popliteal space. Toxins administered for eight months, with decrease in size of tumor; improvement in function of leg, and general condition of patient. He then developed an infection of the sinus, resulting from exploratory incision, necessitating immediate amputation. Patient is well at present, over three years later.

Case XXII.—C. H. S., male, aged forty-seven years. Round-celled sarcoma of lower end of femur, involving the popliteal space; central origin. Toxins given for nine months, with decrease in size of tumor, and improvement in patient's general health. He then had a sudden hemorrhage resulting from a ruptured bloodvessel, necessitating immediate amputation. Patient recovered and is still well three years later.

Case XXIII.—M. F., female, aged thirty-eight years. Sarcoma of fibula, periosteal. Toxins for several weeks before amputation; no appreciable effect, therefore amputation followed by toxin treatment. Patient well at present, two years later.

Case XXIV.—C. M., female, aged twenty-seven years. Periosteal sarcoma of right femur. Amputation advised, but refused by patient. Tumor markedly diminished in size under six weeks' toxin treatment. Patient returned home and tumor again increased in size. Under larger doses and prolonged

treatment, the disease was finally controlled, and the patient is well at present two years later. (Clinical and *x*-ray diagnosis and negative Wassermann.)

Case XXV.—F. L., male, aged thirty-five years. Spindle-celled sarcoma of humerus, periosteal; rapid growth; pathological fracture believed to be entirely beyond amputation. Apparent complete disappearance under five months' toxin treatment, firm reunion of arm. Recurrence necessitating shoulder-joint amputation. Later again followed by recurrence in pectoral muscle. Partial operation followed by toxin treatment. Patient in good health today, four years later.

Case XXVI.—C. M. R., female, aged sixteen years. Sarcoma of upper end of tibia, central. Conservative operation followed by prolonged toxin treatment. Patient in good health four years later.

Case XXVII.—H. P., male, aged twenty-seven years. Very large myxo-, chondrosarcoma of femur, periosteal. Amputation at the hip-joint followed by three months' toxin treatment. Patient in excellent health today, two and one-half years later.

CASES IN WHICH TOXINS WERE NOT USED.

Case XXVIII.—C. H., female, aged twenty-nine years. Myeloid, round-celled and giant-celled sarcoma of lower third of radius; two conservative operations by Dr. Russell Hibbs, first in 1900; second, January, 1902; amputation advised by several surgeons, but refused; patient well when last heard from eight years later.

Case XXIX.—S. L., female, aged twenty-four years. Sarcoma of tibia, upper end; central origin. Amputation below lower third of thigh. Patient well when last heard from ten years later.

Case XXX.—E. W., female, aged twenty-six years. Sarcoma of upper end of tibia, giant-celled; central origin. Amputation by Dr. Bull below lower third of thigh. Patient well

seven years when metastasis occurred in the lung. Death six months thereafter.

CASE XXXI.—O. C. S., male, aged forty-two years. Sarcoma of lower end of femur; central, giant-celled. Amputation advised but refused. Patient in good health two years later without recurrence.

The limb was saved by the preliminary use of the toxins in 11 cases. I cannot, therefore, too strongly urge such preliminary toxin treatment. The few weeks needed to determine the question as to whether the toxins will be of value in the given case is not connected with any appreciable risk, and if it is possible to save the limb in such a considerable number of cases it is certainly worth this trial; even if the toxins fail to control the tumor completely and it is found necessary subsequently to resort to amputation, the preliminary use of the toxins has unquestionably had a modifying effect upon the malignancy of the tumor, in a number of cases at least, as shown *e. g.*, by one of my own cases, a very far-advanced periosteal sarcoma involving the middle and upper thirds of the femur—which I regarded beyond hip-joint amputation. At the end of four months' treatment the growth had been practically entirely inhibited, spontaneous fracture followed and the leg was later amputated at the hip-joint by another surgeon. The patient was well one and one-half years later when last heard from. The case of Sir Frederick Eve is another case in point.

The foregoing summary shows 27 cases in which the toxins were used either before or after amputation, or both.

Femur Cases, 13. Well from one and one-half to ten years; or 10 from three to ten years; 8 of these were of periosteal origin, 5 of central; of the latter, 3 involved the periosteum.

Tibia Cases, 3. Well four, nine, and sixteen years respectively, of which 2 were of central and 1 of periosteal origin. All of them were cured by a conservative operation followed by the toxins.

Radius Cases, 3. Two remained well six years, the other two years. Two were of central and one of periosteal origin.

Two of the cases were cured by curettage followed by toxin treatment; in 1 the toxins were used after amputation.

Humerus Cases, 3. Two were of periosteal origin and 1 of central. In one of these cases the arm was saved, the toxins being given after an incomplete operation. The patient remained well fourteen years later. In the other 2 cases amputation had to be done, and one has remained well four years. The other case finally had a recurrence in the spine and died of the result of the operation.

Ulna Case, 1. Of periosteal origin. This patient received a course of toxin treatment after amputation of the arm, and has remained well for six years.

Fibula Case, 1. Of periosteal origin. Amputation was done two years ago, followed by toxin treatment. Patient is well at present, two years later.

Metatarsal Bone, 1. Of periosteal origin. The toxins were used as a prophylactic after amputation, and the patient was well when last heard from, ten years later.

Clavicle Cases, 2. Both were of periosteal origin. In both cases, total excision was done, followed by a course of toxin treatment. One has remained well five years, the other is still well and free from recurrence at present, six years later.

Twenty-one of the foregoing cases remained well from three to sixteen years, and 14 cases remained well from five to eleven years.

In 11 of the above 27 cases the limb was saved by the use of toxins, and 8 of these remained well from three to sixteen years.

In 16 of the cases the toxins were used as a prophylactic, and in 5 of these they had been given before amputation as well.

It is important to note that my own series of cases differs from every other published series of cases, in that it represents a much larger number of advanced cases, in which the disease had progressed so far that the condition was inoperable and apparently practically hopeless at the time the patients came under my observation.

Diagnosis. The early diagnosis of sarcoma of the long bones requires accurate clinical knowledge of all the conditions most likely to simulate sarcoma. Second, it requires a great amount of actual physical examination and careful clinical study of a large number of cases of sarcoma of the long bones. The tactile sense may be so educated by such experience that it has an inestimable value in making a diagnosis. A careful history of the case brings out important facts which long experience, combined with good judgment, will arrange in logical order, and give proper weight in arriving at the final diagnosis.

Clinical Diagnosis. In a considerable proportion of my own cases, pain has been the first symptom of the disease, preceding the development of the tumor. Pain may vary in character, but it is usually a deep-seated, boring pain, worse at night or after using the limb. In these cases the pain preceded a visible or palpable tumor in nearly one-half. After a tumor has developed to sufficient size to be palpable, there is generally the sign of local heat and in not a few instances there may be a general rise of temperature, amounting up to 101° to 102°. One of my cases, a boy, aged twelve years, with a fusiform swelling in the middle of the femur, showed a daily rise of temperature to 100° to 101° to 101.5°. This, with the local heat, caused the patient to be admitted on the diagnosis of periostitis. I made the diagnosis of periosteal sarcoma, which was confirmed by microscopic examination.

The locality of the tumor may be of considerable help in the diagnosis, particularly when making a differential diagnosis between sarcoma and tuberculosis. Sarcoma very rarely, in the early stages at least, involves the joint or synovial membrane. It may be differentiated from exostosis or osteoma, by the fact that the latter is of slower growth, is usually without pain, harder and more uniform as to consistence, and is very apt to be pedunculated.

Sir Alfred Pearce Gould attaches great importance to the globular expansion of the long bone, holding that:

"True expansion of the bone is a sign of the greatest impor-

tance, and the more limited the area of bone expanded and the greater the degree of expansion the more characteristic this sign and the more likely is the tumor to be a myeloma rather than a sarcoma. The absence of new bone laid down on the surface of the enlarging bone is a striking distinction between a sarcomatous growth and a tuberculous, syphilitic, or inflammatory ostitis.

"I have already pointed out that in the case of a central sarcoma in the earliest stage only the *x*-ray can demonstrate its presence. But the increasing growth of a sarcoma is attended with other features that enable us to identify it. In a myeloma particularly we notice the globular outline of the tumor and its expansion of the bone into a similar globular form. In no other disease is the globular expansion of an epiphysis carried to such a degree; the swelling shows no tendency to extend along the shaft and to involve more and more of the length of the bone. The cancellous bone is rapidly destroyed and the outer shell of bone is truly expanded; there is no real thickening of the bone from new deposit on its outer surface. This is a striking contrast to the condition found in tuberculous or coccal infection of an epiphysis."

Sir Frederick Eve has advanced a theory which is original as far as I know. He asserts that the difference in the nature of myeloma and sarcoma depends rather upon the site of the disease than upon the structure of the tumor; the nearer the body the greater the degree of malignancy would appear to be true of the myelomata as well as the periosteal sarcomata.

My own experience has not been in entire accord with this theory. One of the most malignant tumors that I have ever seen was a periosteal sarcoma of the metacarpal bone and another a sarcoma of the lower end of the ulna. The metacarpal sarcomas are likewise very malignant.

Myeloid Sarcoma. Sir Frederick Eve further states:

"Although it has long been taught that the true myeloma has a low degree of malignancy, yet it is only in recent years that it has been recognized as possessing, at least in some situ-

ations, a purely local malignancy. Butlin, even in 1900, classed the central round- and spindle-celled sarcoma with the myelomata under the common heading of central tumors in discussing their treatment. The broad general statement made in some text-books that the myelomata are only locally malignant required, however, considerable modification. The myelomata of the femur, and especially those of the upper end of the humerus, are sometimes followed by metastasis. According to Butlin's statistics, the tumors were giant-celled sarcomata in three out of five patients who died with metastasis after amputation of the femur for central sarcoma. And in two out of three unsuccessful cases of sarcoma of the upper end of the humerus two were described as myeloid sarcoma."

The question of the relative malignancy of myeloid sarcoma is one that is still far from settled. The opinion held by Bloodgood and others is that giant-celled sarcomas are practically benign and, furthermore, that they never give rise to metastasis. It is evident that the different writers who took part in the Royal Society of Medicine discussion of this question approached it from different points of view. Some include in this type of myeloid sarcoma all endosteal sarcomas, some of which latter are of high malignancy, while others limit the term to small encapsulated endosteal tumors of slow growth, made up almost entirely of giant cells.

I agree with Mr. Gilbert Scott, of London, who in the discussion stated that although myeloid sarcomas are usually of slow growth, they may also be just as rapid in growth, and as fatal, as true endosteal sarcomas or even periosteal sarcomas. At any rate, in my own personal experience in a number of cases in which the pathologist's report of the tumor stated that it was a giant-celled tumor of the epulis type, the disease ran a clinical course of extreme malignancy, causing the death of the patient within a few months, and often associated with metastasis. Histologically there is apparently no difference between this type of tumor and the slow-growing epulis of the jaw.

With regard to the question as to whether these myeloid or giant-celled endosteal tumors ever produce metastasis, opposite opinions are held. Maybury cites two cases of myeloid sarcoma, observed at St. Thomas' Hospital, in both of which the patients died of secondary deposits in the lung: Case I, was a girl, aged sixteen years, with sarcoma of the femur of three months' duration; exploratory operation and microscopic examination. Amputation done; metastasis of the lung seven months later, causing death. In Case II the disease occurred in the bone of the pelvis; amputation; metastasis of lung; death eight months later. Slides of both of these cases were presented at the discussion of the Royal Society of Medicine and were pronounced typical specimens of giant-celled sarcoma.

My own cases strongly support the view held by Mr. Maybury on the subject.

The following personal case I believe to be worthy of a detailed report, inasmuch as it has an important bearing upon the question of the malignancy of myeloid or giant-celled tumors, about which there is such great difference of opinion here and abroad.

Sarcoma of the Humerus. H. B., male, aged ten years, was referred to me on March 16, 1910, by Dr. Bellis, of Trenton, New Jersey, with the following history: Had a fall upon the ice five weeks before, striking upon his left shoulder and upper arm. He could not use the arm after the fall, and was seen by physicians, who found loss of power and evidence of fracture at the junction of the middle and upper third of the humerus. He was put in a plaster cast. Three weeks later, or two weeks before I saw him, on removal of the splint a tumor of considerable size was found at the point of fracture. This was regarded at first as redundant callus. It was watched for a week, at the end of which time it had markedly increased in size. The patient was then seen by Dr. Bellis, who found a large tumor of the upper third of the humerus, enlarged veins, having the typical appearance of a sarcoma. The tumor increased rapidly in size and a week later, March 16, 1910, Dr. Bellis referred the

patient to me. Physical examination at this time shows the left humerus enormously enlarged, measurements being $12\frac{3}{8}$, $13\frac{7}{8}$, and $14\frac{1}{2}$ against $7\frac{7}{8}$, 10, and $11\frac{1}{2}$ inches on the opposite side. All superficial veins were greatly enlarged and bluish in appearance. The tumor extended beneath the pectoral muscle to the middle of the clavicle, and posteriorly to the edge of the scapula. Some glands could be felt in the axilla. There was very little loss of weight. The *x*-ray showed what I believed to be the

FIG. 1.—Case H. B. Sarcoma of humerus. Amputation. Interscapulothoracic. Tumor of only five weeks' duration. Giant-celled. Death from metastasis in lung one year later.

typical appearance of sarcoma. Without waiting for a pathological confirmation of the diagnosis which seemed to be perfectly clear, and in view of the apparent high degree of malignancy of the disease as evidenced by its rapid growth, I believed it unsafe and unwise to do an exploratory operation, and determined to amputate at once, which I did at the shoulder-joint. The patient made a satisfactory recovery from the operation

and was put upon small doses of the mixed toxins, which were continued twice a week by his local physician for about two months; then once a week for another two months. The report of the microscopic examination made by Dr. James Ewing, Professor of Pathology at Cornell University, reads as follows:

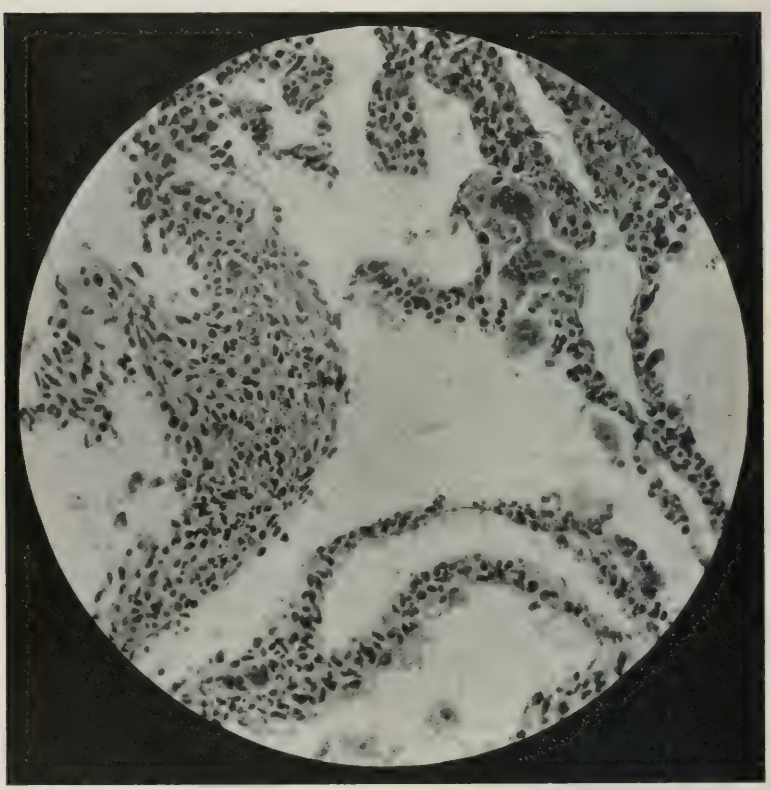

FIG. 2.—Case H. B. Sarcoma of humerus. Microscopic examination: giant-celled epulis type. Death from lung metastasis in one year.

MARCH 21, 1910.

"The process in the humerus proves to belong in the class of giant-celled sarcoma. It consists of wide blood spaces surrounded by thin strands of loose cellular tissue composed of spindle cells. The spaces are partly lined by giant cells and some few giant cells are found within the strands of tumor

tissue. By far the larger part of the bulk of the tumor is made up of blood spaces. The tumor has exactly the structure of the giant-cell epulis, and I think, therefore, that it has the same moderate degree of malignancy."

From the histological appearance of the tumor, Dr. Ewing was so impressed with its low grade of malignancy that he believed that I had been in error in doing such a radical operation, since he had seen asimilar case which had been cured by curetting.

The subsequent history of the case is of interest: December 26, 1910, Dr. Young writes: "The boy is in excellent health, and shows no sign of any trouble."

May 31, 1911. I examined the patient personally and found he had a slight cough, no loss of weight, and no physical signs of a recurrence. Soon after he began to show great lassitude, general malaise, and less ability to bear exercise.

June 30, 1911. Physical examination by myself showed very marked dulness in the right apex, shortness of breath; slight, hacking cough. The clinical signs in the chest increased, the patient's general condition rapidly deteriorated, and he died August 20, 1911, fifteen months after the operation.

It is but fair to say that on later examination of the specimen by Dr. Ewing he inclined to the belief that the tumor in question belonged to the rare type of bone aneurysm of a very high degree of malignancy, rather than to the epulis giant-cell type.

If this be true it only goes to show that the two types of tumor may so closely resemble each other that the most expert pathologists with the widest experience are not always able to distinguish them.

In connection with the generally supposed benign character of giant-celled sarcoma, I would further mention the following:

Case observed at the General Memorial Hospital two years ago, on the service of Dr. Charles N. Dowd:

Male, aged twelve years. Tumor of the lower jaw. Microscopic examination showed it to be a myeloid sarcoma of the epulis type, supposed to be of very benign character. In spite of operation it recurred promptly and grew with great rapidity, causing death within four months.

I had a very similar case four years ago of a tumor occurring in a young woman, aged eighteen years. Patient went to the Thirty-third Street Hospital where, under ether anesthesia, Dr. Downes and I removed a large portion of the tumor, which was easily extirpated by a curette and a large spoon. Microscopic examination was made by Dr. James Ewing, who pronounced the disease myeloid sarcoma of the epulis type. The patient was put upon the mixed toxins, but the tumor grew so rapidly that it was thought inadvisable to continue the treatment. The patient steadily grew worse and died about a month later. In this case the total duration of life was four months from the time the tumor was first noticed.

FIG. 3.—R. F. Sarcoma of humerus.

Sarcoma of Right Humerus. Very highly malignant yet microscopically of the epulis type. R. F., aged fourteen years; no history of tuberculosis or cancer in the family. Patient had always been in good health until June, 1911, when she noticed

pain in the upper part of the left shoulder, followed by noticeable enlargement; the swelling increased in size and the pain continued. She was brought to me by her family physician, Dr. L. I. Mason, of Willimantic, Connecticut, on September

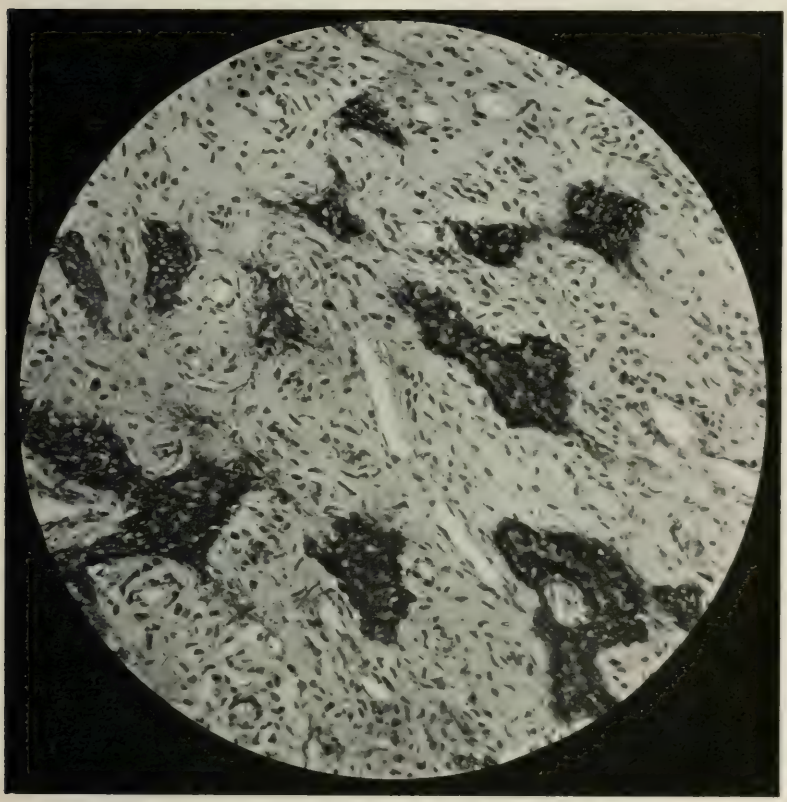

FIG. 4.—Case R. F. Microscopic report: osteoid medullary giant-celled sarcoma of humerus: very malignant; metastases shortly after amputation.

21, 1911. From the clinical appearance of the tumor combined with the *x*-ray I made the diagnosis of periosteal sarcoma. Without any exploratory operation I decided upon immediate amputation, which was done on August 23 at the General Memorial Hospital. The tumor was examined by both Dr.

W. E. Clark, pathologist at the General Memorial Hospital, and Dr. James Ewing, professor of pathology at Cornell University Medical School.

The former reported: "Biceps tendon undergoing degeneration, edge of specimen contains small amount of tumor tissue."

Dr. Ewing's report reads: "The tumor is a mixed type of giant and spindle cells of the epulis variety."

The mixed toxins were begun on September 6, the injections being made in the pectoral region. She received four treatments while in the hospital, the largest dose being 2 mm., which was followed by a chill and temperature of 101°. On October 16 she went home to have the treatment continued, but her condition grew worse so rapidly that only two small doses were given. On September 25, a recurrence was noted. The wound had not yet entirely healed and there was a recurrent mass, the size of a thumb nail appearing in the scar. This increased rapidly in size. The patient's general condition markedly deteriorated. The recurrent tumor grew with phenomenal rapidity and the patient died on October 28, a little over two months after amputation, or three months after the first signs of the disease were noticed.

The X-ray in Diagnosis. While the *x*-ray may often be misleading in the early stage of sarcoma of the long bones, it may also be of valuable help in making an early diagnosis. In order to properly estimate its value, large experience in interpreting the *x*-ray photograph is required. In periosteal sarcoma we may have lesions that closely simulate sarcoma, especially in the non-ossifying type, in which no new bone is developed, the old bone being eroded or partially destroyed. Tuberculosis, syphilis, and chronic osteitis may simulate this condition. The *x*-ray is of very great help in such cases. Here we have a tendency of new bone to form spicules which stand out or radiate at right angles to the shaft of the bone, and in the opinion of many authorities, this particular arrangement is characteristic of sarcoma. I would not go quite so far as to endorse this as there are important exceptions to this rule.

The *x*-ray shows little or no difference between a sarcoma of the shaft of the bone and a carcinoma of the bone secondary to primary carcinoma elsewhere in the body. The clinical

FIG. 5.—Osteomalacia. All long bones involved. (Courtesy of Drs. Gibney and Darling.)

history should settle this point. In endosteal tumors the *x*-ray may not enable one to differentiate between a bone cyst and a central sarcoma, but the clinical history may often help to make a differential diagnosis.

The following case shows that the sharply defined periosteal line, which can usually be relied upon as an important diagnostic sign in the differential diagnosis between myositis ossificans and periosteal sarcoma, occasionally fails:

H. W., female, aged eighteen years, entered my service at the General Memorial Hospital in June, 1910, with the following history: She had noticed pain or a drawing sensation at the juncture of the middle and lower third of the right thigh for three to four weeks. The pain gradually increased and a little later a swelling could be detected in this region. There was no history of injury. Physical examination showed at the junction of middle and lower third of the right thigh a fusiform enlargement, apparently connected with the bone, of moderately hard consistence and not tender. The skin was slightly reddened from external applications which had been made at one of the large surgical clinics for two weeks, on the supposition that the trouble was of inflammatory character. I had an *x*-ray photograph taken which showed a slight fusiform enlargement in the lower third of the femur and a clearly defined apparently normal periosteal line, quite as well defined as one sees in myositis ossificans, with none of the indentations or erosions so characteristic of sarcoma of the femur in its early stages. In the absence of any previous injury I made the diagnosis of sarcoma of the femur, which was confirmed by microscopic examination of a portion of the tumor removed by exploratory operation. The patient refused amputation as well as further toxin treatment. Later history of the case unknown.

The following two cases, for the histories of which I am indebted to my colleague, Dr. William A. Downes, show the importance of repeated or serial *x*-ray examinations in the early stages when the diagnosis is in doubt:

Case I.—A. G., male, aged thirty-six years; admitted to St. Luke's Hospital on July 18, 1913. Family history negative. Personal history: Seven months before the patient had fallen upon his hip. He returned to work after a few days, although he had local pain, which was attributed to rheumatism. He consulted the Out-patient Department of St. Luke's Hospital, and was told that he had hip trouble. A month before his admission to St. Luke's Hospital he had stayed at the J. Hood Wright Hospital for seven days, where the diagnosis of tuberculous hip-joint was made. During the entire time the patient had severe pain, starting in the hip and radiating down the leg. These pains were more severe at night. The first *x*-ray plate taken at St. Luke's Hospital, shortly after his admission, on July 18, 1913, showed nothing characteristic of sarcoma; one taken two weeks later later showed distinct changes in the outline of the bone and evidence of new growths. At this time an exploratory operation was done and the pathological diagnosis of fibrosarcoma of the femur made. The disease was then too extensive for hip-joint amputation. The tumor grew very rapidly and the patient died a few weeks later. The entire course of the disease was nine months.

Case II.—Central sarcoma of lower end of femur and popliteal region. S. F., female, aged sixteen years; admitted to St. Luke's Hospital on August 28, 1913, discharged December 5, 1913. Tuberculosis in family. Personal history: Two months before admission the patient noticed a slight stiffness about the knee, which gradually increased and was accompanied by some swelling; walking became more and more difficult; no redness about the joint, although at times there was some tenderness and local heat. No history of antecedent trauma, except that her foot was hurt in an elevator one and one-half years before. The first *x*-ray plate taken showed practically nothing abnormal. Three weeks later a second *x*-ray, taken in the same position, showed a distinct enlargement, very characteristic of sarcoma. Dr. Downes then immediately amputated at the hip-joint. The patient is well at the present time, nearly one year later.

The difficulty in making an early diagnosis in many cases of sarcoma of the long bones is illustrated by the following case:

S. E., aged twenty-three years, male, was thrown from a horse in July, 1912, sustaining abrasions of the face and right elbow, and a severe shaking-up. In the latter part of August he noticed pain in the right shoulder, directly over the head of the humerus and acromion process of the scapula. *X*-ray examination proved negative. He showed some improvement under local application of heat. In October another *x*-ray was taken and showed a rarefying osteitis. The trouble was regarded by the attending physicians and consultants as probably a tuberculous joint. One month later he began to have attacks of indigestion; at the same time the shoulder became tender and somewhat swollen. The patient was examined by prominent specialists in orthopedic surgery and internal medicine, but no diagnosis could be made until the middle of December, 1912, when an enlarged gland appeared beneath the pectoral muscle near the head of the humerus. This was removed and pronounced round-celled sarcoma at the Bender and Harvard laboratories. The patient's general condition rapidly deteriorated; he became greatly emaciated and suffered severe pain. The toxins were begun on December 20 and continued for two weeks, at the end of which time I saw him in consultation. I found him in such an extremely emaciated condition, with such a weak, rapid pulse that I advised against further treatment. He died a few weeks later. At the time of my examination there was a large tumor of the upper end of the humerus, apparently involving the entire circumference of the humerus with probable extention into the scapula.

In this case, though the patient had the advantage of very early *x*-ray examinations and consultation with leading specialists in surgery and medicine, no diagnosis was made until metastases had occurred and the patient was far beyond help. In this case and in many others I suspect we do not lay sufficient stress upon persistent severe and localized pain.

In a very considerable number of my cases this kind of pain

has been a prominent feature in the earlier stages of the disease, yet it has merely served to render the diagnosis of rheumatism acceptable to the patient and his friends, and has not aroused the suspicion it should that the trouble in question might be sarcoma.

Exploratory Operation and Microscopic Examination of Specimen Removed; Advantages and Disadvantages. *Advantages.* That the removal of a portion of a tumor and the report upon its histological structure by a competent pathologist is of the greatest advantage cannot be questioned, and under ordinary conditions, I believe, we should avail ourselves of this aid.

Disadvantages. There are, however, very definite and weighty objections to the exploratory operation in sarcoma of the long bones which, in the opinion of many very high authorities, notably Mr. Ballance and Mr. Makins, of London, may equal or exceed its advantages.

A. There is the danger that the mere cutting into the tumor, particularly a vascular round-celled sarcoma, may set free tumor cells which, entering the circulation, are carried to remote parts of the body, and give rise to early metastases. A number of cases have been cited, that furnish convincing evidence that such a result has occasionally followed exploratory operation.

B. There is the objection that the exploratory operation may do permanent damage in the way of causing sinuses that do not heal and which may become infected and later give rise to serious conditions, as seen in two of my own cases.

C. The last, but by no means least important disadvantage is the risk that the exploratory incision, by reason either of not having been carried deeply enough, or by not happening to include a sufficiently characteristic portion of the tumor, necessarily leads to a negative report from the pathologist. With such a negative report on the one hand, yet with the clinical and *x*-ray data on the other hand, strongly pointing to sarcoma, the surgeon is placed in a very difficult situation.

While many surgeons advise exploratory operation as a routine measure in all cases of sarcoma of the long bones, and others are so impressed with its disadvantages and risks, that they seldom or never resort to it, my own experience has led me to adopt a middle ground, which may be briefly stated as follows:

In cases in which the history and clinical signs are very strongly positive, I would not subject the patient to the risk of an exploratory operation, but would proceed immediately to perform the operation which seems best adapted to the individual case. I have on two occasions performed total excision of the clavicle for a rapidly growing periosteal tumor of only three weeks' duration. In both cases the clinical appearance of the tumor, confirmed by the *x*-ray picture, together with a history of the tumor's having appeared almost immediately after an injury, made the clinical diagnosis so strongly positive that it seemed unwise to submit the patient to the risk of exploration.

Another case which I recall was that of a very large tumor of the upper end of the humerus, immediately following a fracture. The tumor had attained this large size in the short period of three weeks. It was associated with enlarged veins, and the *x*-ray gave a typical picture of sarcoma. I believed that, cutting into such a vascular tumor as this for the sake of verifying the diagnosis which seemed practically certain without such evidence, was unjustifiable. It might be urged, on the other hand, that in such cases an examination of a frozen section should be made at the time of operation, before any radical operation was performed.

To this I would reply that, in my opinion, the clinical history of a case and the macroscopical appearance of the tumor to one who has had a large experience in sarcoma, is of much greater value than the microscopic examination made from a frozen section. In the humerus case which I have just cited, the examination from the frozen section or exploratory operation would have been a distinct disadvantage, for the pathological

report made on the basis of an examination of the entire tumor, pronounced it giant-celled sarcoma of the epulis type, and the pathologist stated that he believed amputation was not indicated, and that the disease could be cured by curetting alone. Having nothing but the clinical evidence to go by, I did a shoulder-joint amputation. The patient made a good recovery, but in spite of a brief period of toxin treatment following the operation, within nine months extensive metastasis occurred in the lungs and the patient died a few months later.

Furthermore, I would not make use of an exploratory operation in another group of cases in which, though the clinical evidence is less strong and positive than in the preceding group of cases, the anatomical location of the tumor is such as to render probable a hemorrhage that might be difficult to control, or an even greater probability of a resulting sinus, difficult or impossible to heal. I would never again explore a probably sarcomatous tumor located in the lower end of the femur, situated behind the popliteal space, as I did in two cases already reported.[1]

My experience in the two cases which I have cited has convinced me of the disadvantages of exploratory operation in such cases. The better plan in this group of cases in my opinion would be to assume the diagnosis of sarcoma to be correct, in the absence of evidence pointing to tuberculosis and with a negative Wassermann reaction, and to give the patient a brief course of treatment with the mixed toxins. During this treatment the clinical signs and measurements should be confirmed by a series of *x*-ray pictures taken at short intervals, *e. g.*, every two to three weeks. If it becomes evident that the disease is progressing, one can then resort to an operation, not merely an exploration, but such an operation as seems best adapted to the particular case, curetting, resection, or amputation. Before ever resorting to amputation I would first cut into the tumor. The gross appearance would, in the great majority of cases, be sufficient

[1] Myositis Ossificans, Annals of Surgery, March, 1913.

to establish the diagnosis beyond question. But if there were still doubt a frozen section could be made, or, in my opinion, a better procedure would be to remove sufficient material for a thorough examination, close the wound, and defer the final operation until a careful histological examination can be made. Cases in which this latter procedure becomes necessary should be extremely few in number.

Cases in Which Exploratory Operation is Indicated. 1. Cases of sarcoma of the upper end of the tibia, or lower end of the radius, in which it is most important to know whether we are dealing with a mixed-celled or highly malignant sarcoma, or a giant-celled or myeloid type of sarcoma, of a low degree of malignancy. The type of tumor in this case would determine largely whether it was necessary to sacrifice the limb, or whether one could be content with a conservative operation to be followed by a course of toxin treatment.

2. The exploratory operation is indicated in periosteal sarcoma of both the shaft and the extremities of the long bones, especially in the early stages. Here I do not believe we run a great risk of causing dissemination, and my experience has been that the sinuses following the operation heal much more readily than in the more deeply seated or central sarcomas. In addition, the risk of hemorrhage is not nearly so great. The principal disadvantage is that the microscopical examination may be negative. In cases in which we are still in doubt, we must determine on other and clinical grounds whether to operate or wait. One of my cases of myositis ossificans, reported before the New York Surgical Society at its meeting on December 11, 1912,[1] shows that it is not always easy to do the right thing, with all possible data at our command and all known aids to early diagnosis. In certain cases we are sometimes bound to fail. In spite of the disastrous ending in this particular case, I feel the proper course was pursued, at least at the time of the first exploratory operation, and I further believe we were justified in delaying amputation after such a strong

[1] Annals of Surgery, March, 1913.

negative report of the pathologist's upon the material removed at an extensive exploratory operation. How long one should wait is another question and can never be answered in general terms. With clinical signs of increase in size plus the characteristic appearance of a periosteal sarcoma shown in a skiagram I am now convinced that in some cases at least one is justified in sacrificing the limb, even in the face of a negative pathological report.

With regard to the difficulties and uncertainties of exploratory incision, Elmsley cites the following cases illustrating this point:[1]

"In the museum at St. Bartholomew's there were two specimens of great interest and importance. Each was a femur containing a patch of necrosis and a large mass of inflammatory new periosteal bone around. Each of them was amputated under the impression that it was sarcoma, after exploratory incision into the tumor. They occurred before the days of skiagraphy; nowadays, no doubt, a good skiagram would lead to the diagnosis being made. In these two cases the exploratory incision failed because it was not carried deep enough." He believed that the majority of mistakes and failures after exploratory incision were due to the surgeon not cutting deep enough, or not cutting into the right part. One such case occurred to him.

Mr. Makins does not agree with Sir Frederic Eve in the opinion that the dangers of cutting into a sarcoma have been over-rated. He cited cases in his own experience which convinced him that such exploratory operations sometimes cause a rapid generalization of the disease. The present custom is never to cut into a sarcoma of the long bones unless prepared to amputate within twenty-four hours.

The following case illustrates well the difficulties that sometimes confront the clinician when he has received two diametrically opposite or strongly conflicting reports from different pathologists:

[1] Discussion, Royal Soc. of Med., November, 1912.

F. C., male, aged seventeen years, son of a prominent surgeon in New York State, had noticed a tumor at about the centre

FIG. 6.—Case F. C. Microscopic examination: (1) chondrosarcoma; one report; (2) myositis ossificans, another report.

of the biceps muscle of the right arm for a period of two to three weeks. The father of the boy, who removed the tumor, gave the following history:

JANUARY 24, 1914.

"The tumor was firmly embedded and adherent to the muscle, extending nearly to its outer surface and running clear through the muscle and attached to the periosteum, but not firmly

attached. There was no encapsulation, the muscle fibers being directly adherent to the growth itself."

The patient had suffered no pain. Family history was negative. A portion of the tumor was submitted to three different pathologists; one, a pathologist of wide experience, stated that it was a chondro-osteo-sarcoma. The second stated that it was not malignant, at least only in a small degree. The third report, made by a distinguished professor of pathology in one of the leading medical schools in the country, read as follows:

"Sections of the tissues from the biceps in the case of F. C. show a picture which I interpret as myositis ossificans. The muscle tissue is the seat of extensive fibrosis and in the centre of this fibrous area there are numerous actively forming bony trabeculæ. The type of bone formed is over cellular and there are mixtures with cartilage. Quite a few giant cells are found in some areas, but nowhere is the picture that of straightforward sarcoma. Nevertheless, I feel that some traumatic sarcomas start in this way; yet the sarcomas are sarcomatous from the start, and this is not sarcoma."

I was asked for an opinion as to the best course to pursue. In view of my unfortunate experience with the case of myositis ossificans of the lower end of the femur, quoted in full in the *Annals of Surgery* for March, 1913, p. 307 (Miss A.[1]), in which a highly malignant sarcoma eventually developed, followed by early metastases and death, I believed it wise to act on the supposition of a possible sarcoma in this case and, therefore, put the patient upon prophylactic doses of the mixed toxins of erysipelas and Bacillus prodigiosus last January. He is still in good health without any trace of a recurrence.

[1] The early report of the pathologist (Dr. James Ewing) in this case read: "Seven different portions of the material received are under examination. *In none of them is there the slightest trace of any form of sarcoma.* The tissue shows chronic osteitis and myositis, such as commonly arises after traumatism to the bone or periosteum. The changes in the muscle are not those typical of myositis ossificans, and yet new bone appears to be forming in close proximity to the atrophying muscle. I should prefer to give the diagnosis of chronic formative osteitis."

Anent the same question, Mr. Edred M. Corner, of London,[1] states:

"For a long time some clinicians have recognized the doubtful value of the microscopist's diagnosis of sarcoma, particularly in children. Dr. Nabarro and Mr. Higgins have now reported most fully an indubitable case in which a similar doubtfulness was shown to exist in the diagnosis of carcinoma by "most high" morbid anatomists. Such a record tells us that cases of the cure of malignant disease cannot be accepted when based upon mere microscopical evidence. The final court of appeal is the clinical court. And if the opinions of that court differ from those of the pathologists, the "casting" vote is with the clinicians. All these considerations thrust increased responsibility on the clinician, who must not rest content with the mere practice of his art, but must keep abreast with and advance the science of surgery."

If we go outside of the strict limits of the long-bone tumors we find even more striking proof that we should not attach too great weight to a negative pathological report of a specimen removed by exploratory operation. Elmsley, in referring to two cases the specimens of which he found at St. Bartholomew's Museum (femurs) states his belief that the majority of mistakes and failures after exploratory incisions are due to the fact that not enough tissue is removed to show the characteristic structure of the growth. I agree with him that this is probably true in the majority of cases in which the pathological reports are in error; yet I recall one case that has impressed itself very strongly upon my mind, namely, that of a rapidly growing tumor of the testicle, immediately following an injury, and which had attained the size of a closed fist in four weeks. An aspirating needle drew only blood. Relying upon my clinical diagnosis of a highly malignant tumor, I immediately operated, removing the entire testicle through a Bassini incision, as for an inguinal hernia. I also removed the cord as high up as

[1] British Jour. of Surg., April, 1914.

possible. The entire tumor was sent to the laboratory and was carefully examined by two of the most competent pathologists—one a professor of pathology in a leading medical school—and the report was that no evidence of malignancy existed. I still believe the clinical diagnosis correct. Three months later the patient entered Bellevue Hospital with a large retroperitoneal tumor. An exploratory operation was done and a portion of the tumor removed by Dr. B. F. Curtis. Microscopic examination at this time proved it to be round-celled sarcoma. The man died a few weeks later, the entire course of the disease covering a period of only five months.

Another striking case in my own experience is that of a boy, aged twelve years, with a rapidly growing tumor of the scapula. A portion was removed by another surgeon and pronounced by a competent pathologist "hyperplasia," with no evidence of malignancy. The large tumor diminished to nearly half its original size under the mixed toxin treatment. The patient was then sent to my service at the General Memorial Hospital. The clinical as well as the *x*-ray diagnosis of sarcoma being absolutely certain, I wished to have it confirmed by the microscope, and therefore removed another good-sized portion of the tumor and from the deeper part, and had it examined by another pathologist, who made the same diagnosis as the former. Shortly afterward the tumor began to increase in size in spite of further treatment, and glands developed above the clavicle; one of these, the size of a hickory-nut, was removed for microscopic examination and again a negative report was received, "no evidence of malignancy found." The disease progressed very rapidly and killed the boy within a few months, and finally microscopic examination confirmed the original clinical diagnosis of sarcoma.

In the discussion of sarcoma (Royal Society of Medicine, November, 1912) it was stated that there was at present little evidence upon which to base the prognosis in cases of chondrosarcoma. The following cases may be of interest in this connection:

Case I.—Subperiosteal sarcoma of the tibia. E. McG., male, aged sixteen years. Family history negative. Personal history: Was struck over the upper portion of the right tibia by a hockey stick. One month later he noticed a swelling at the site of the injury and some tenderness, but little pain. In March, 1911, the swelling, which was regarded as an abscess, was opened by a physician. Nothing but blood was found. The enlargement slowly increased in size. On April 20 a second operation was performed and a tumor, apparently of periosteal origin, was found, fusiform in shape, beginning three inches below the joint and extending downward five inches. Some grayish-white, non-vascular material was removed. The substance of the tumor was found smooth and hard, without erosion; the growth evidently originated in the shaft of the tibia. A microscopic examination was made by Dr. Collison, pathologist of the Post-Graduate Hospital, who pronounced it simple chondroma, non-malignant. Primary union occurred. A local recurrence was noticed six weeks later. An *x*-ray taken before the operation showed nothing characteristic. A third operation was performed on June 25, 1911. The tissue at this time was examined by Dr. Jeffries, pathologist of the Polyclinic Hospital, and pronounced mixed-cell sarcoma, of mild malignancy. A small swollen gland beneath the sartorius muscle, the size of an English walnut, was removed. The tumor recurred almost at once and grew very rapidly.

Physical examination by myself, September 6, 1911, showed a very large tumor at the junction of the middle and lower thirds and extending to the upper end of the tibia, which was three times the size of the other side; there was a fungating mass in the centre, bleeding easily. The disease ran a rapid course.

This case again proves that we cannot place too implicit reliance upon a negative pathological report or a report of a benign lesion in tumors of the long bones. The first report of the pathologist read: Chondroma, non-malignant, in spite of an almost immediate recurrence with rapid growth. The

report of the second pathologist stated: Mixed-celled sarcoma of mild malignancy. Recurrence again quickly followed with metastases in the glands.

My experience in sarcoma of the long bones, and in fact, bones in general, has been that in certain cases, a tumor, pronounced pure chondroma by the pathologist, promptly recurs, and may exhibit a high degree of malignancy.

That chondrosarcoma may be of extreme malignancy is shown by the case reported by Henry J. Clarke of the Doncaster Royal Infirmary, London.[1] The history in brief is as follows:

Youth, aged fifteen years, injured while playing football on October 3, 1911. He first consulted a physician on October 11, who took the trouble for a sprain. Seen by Mr. Clarke November 1. Physical examination at this time showed a tender spot over the external semilunar cartilage; no swelling; joint freely movable. November 8, confined to bed; pains in all joints. Temperature, 102°; thought to be acute rheumatic fever; there was no swelling. November 11, the pains had left the other joints but a stabbing pain remained in the right knee, which grew worse at night; temperature still higher in the evening. Bone abscess suspected. November 18 an *x*-ray was taken which showed a lesion in the upper end of the tibia.

Operation, November 27, disclosed a cartilaginous tumor eroding its way into the head of the tibia, and apparently attached to the outer end of the epiphyseal cartilage. The tumor was excised and a small cavity, about 1½ inches in size, was left in the head of the tibia.

The specimen was sent to the Clinical Research Association, London, for examination, and the following report was received:

"The bulk of the specimen is composed of cartilage but it contains an unusual amount of cellular elements, and on one surface these are proliferating freely and producing a mass of tissue having the characters of a spindle-celled sarcoma. There is no normal tissue included with the growth, so that we are

[1] London Prac., 1912, xlvi, 869.

unable to say to what extent it infiltrates. We must, however, regard it as a chondrosarcoma, probably not highly malignant."

In view of the pathological report it was decided to wait. The wound healed by first intention. The progress was favorable until December 24, one month later, when hemorrhage commenced and continued from the sinus left by the drainage tube. The patient became rapidly worse; the pain was very intense, requiring morphin. An unusual feature of the case was the temperature which remained high, reaching 104° some evenings. Curettings removed through the sinus were sent to the Clinical Research Laboratory, who made the following report:

"These fragments are composed of a chondrosarcomatous growth, which consists of small spindle-shaped cells and a few myeloid elements. The cartilaginous tissue is small in amount and is infiltrated with calcareous material. There can be no doubt of the malignancy of the formation."

Amputation of the thigh was done on January 5, 1912. The patient made a satisfactory recovery, the wound healed by primary intention; his general health rapidly improved, and he was discharged from the Hospital on February 7. All went well until March 10, when he began to have violent headaches, vertigo, and vomiting. The symptoms rapidly grew worse and died shortly afterward from secondary deposits in the brain. There was no local recurrence. The entire duration of the disease was less than five months.

A brief report of the following personal cases, bearing upon the malignancy of the disease, may be of interest:

(1) M., male. Tumor of the ilium. Patient was referred to me in 1894 by Dr. George Shrady with a very large tumor of the ilium. Microscopic examination showed it to be a chondrosarcoma. The tumor entirely disappeared under the mixed toxins treatment. Seven months later the disease recurred, grew very rapidly, and killed the patient within a year.

(2) *Inoperable Osteochondroma of Intraclavicular Region.* R. B., male, referred to me by Dr. J. F. Erdmann, of this city, in

August, 1911. Patient had injured a rib eight years ago; four years later began to notice that his left shoulder was raised. Two years after that he noticed a hard, painless swelling in the left pectoral region just below the clavicle. This gradually increased in size and in 1910 began to interfere with the movements of the arm. The *x*-ray diagnosis was "in all probability osteochondroma." I first saw the patient in August, 1911, at which time physical examination showed a markedly protuberant tumor occupying the whole left pectoral and axillary region, extending up to the clavicle. The skin was normal in appearance, although the veins were slightly enlarged. The tumor itself had a very hard, cartilaginous "feel." It was irregular, nodular, though somewhat variable in consistence. The left clavicle seemed to have been disarticulated from the sternum and raised $1\frac{1}{2}$ inches above its normal position. Just above the clavicle, apparently springing from it, there was a firmly fixed growth not quite the size of a hen's egg. The axillary glands were not involved. The toxin treatment was begun with the result that under the treatment the tumor was reduced to one-fifth of its former size. At the end of two weeks the incision was made and broken-down tissue removed; free drainage was continued for two months. The patient's general health became greatly improved, so much so that he discontinued taking the toxins. Soon after the disease began to grow again and gradually attained to more than its original size. He was later treated by another surgeon with extremely large doses of radium. However, he died in the latter part of 1913. Dr. Ewing's report in this case read: pure chondroma.

(3) *Chondroma of the Femur.* Amputation below the trochanter, 1909. Patient remained well for nearly five years, when she had a local recurrence in the gluteal region about the size of a child's head. This was removed by me in January, 1914. Microscopic examination by Dr. James Ewing showed it to be a pure chondroma. Three *x*-ray treatments were given after operation, and prophylactic treatment with the mixed toxins was given for two months. She is in good health at present.

Another interesting case associated with chondrosarcoma I recently observed at St. Vincent's Hospital on the service of Dr. F. S. Dennis. The history is briefly as follows:

(4) Male, aged thirty-seven years; tumor developed in the ilium shortly after a severe bruise from falling into a coal hole. In the course of a year it grew to a very large size, measuring 31 cm. in both directions and was entirely inoperable. A portion removed for microscopic examination was pronounced chondrosarcoma of spindle-celled type by the pathologist of Bellevue Hospital. The mixed toxins were begun January 1, 1914, under my direction, chiefly local injections being made. Under less than a month's treatment the tumor became largely necrotic and fluctuating. I advised free incision and drainage, under ether, which was done; the sloughing continued with very profuse discharge. One month later four applications of radium were given by Dr. J. B. Bissell. The patient continued to improve and was discharged from the hospital in April, in good condition, with only a small superficial sinus an inch deep remaining.

Subsequent Note. On June 5, I made a physical examination of the patient and found no trace of the tumor; his health and weight had been restored to normal and he had returned to work. The sinuses had all healed.

In many of the cases of periosteal sarcoma of the femur I have found the presence of cartilage mixed with round and spindle cells rather than pure chondroma. I believe, however, that the prognosis in such cases is not materially affected by the cartilage. They are all highly malignant.

Space will not permit a detailed report of these cases here. My paper on "Sarcoma of the Long Bones," published in 1907, contains a tabulated report of some of the cases, the subsequent histories of which have been published in later papers. I merely refer in detail to a few of the more important cases:

Sarcoma of the Humerus. F. L., aged thirty-five years. No history of cancer in the family; a man of splendid physique, six feet tall, weighing 180 pounds. Early in January, 1910, he fell and received a spiral fracture of the left humerus at about

the junction of the middle and upper thirds. He was treated at the Hudson Street Hospital and then returned to Baltimore, where he was treated by Dr. W. A. Fisher. An *x*-ray taken at this time showed a spiral fracture without any trace whatever of a new growth. Two to three weeks later he began to have

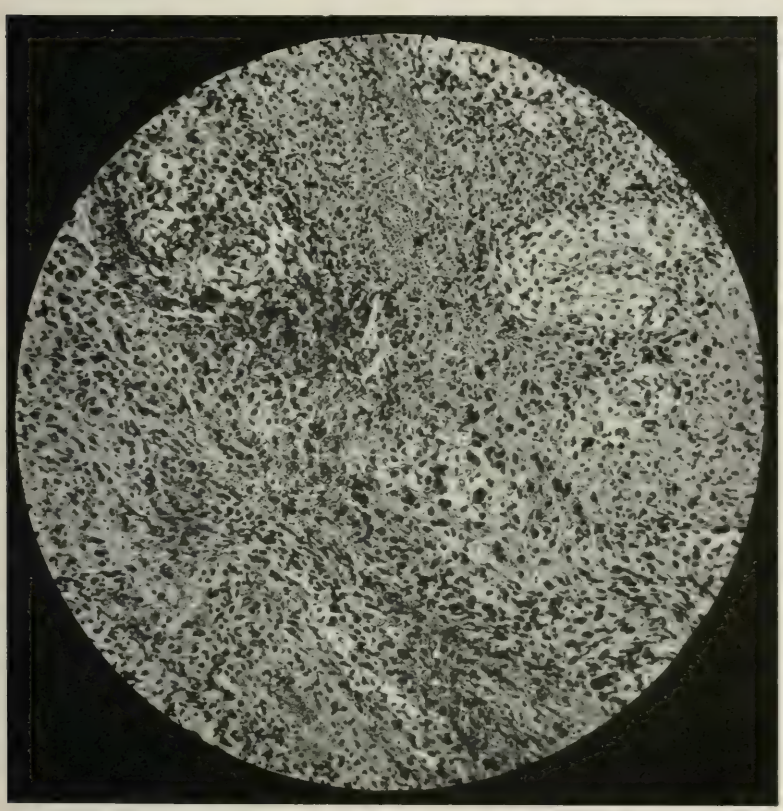

FIG. 7.—Case F. L. Periosteal sarcoma of humerus; round- and spindle-celled.

severe pain at the site of the fracture. Another *x*-ray photograph was taken, showing that in the meantime there had developed a well-marked tumor, apparently a sarcoma, involving both the central portion and the periosteum. The growth increased rapidly in size and was accompanied by very severe and constant pain.

In June, 1910, an exploratory operation was performed by Dr. J. M. T. Finney, who found a large sarcomatous growth, involving both the central and periosteal portion of the humerus and extending from about the junction of the middle and upper thirds nearly to the head of the bone. The bone was completely destroyed; a pathological fracture had occurred and there was a flail joint. The central portion of the tumor was curetted; in Dr. Finney's opinion amputation offered no hope of a cure.

The patient was referred to me by Dr. Finney for the toxin treatment, which was begun June 16, 1910, and continued in small doses, most of them being given systemically in the pectoral region, and a few in the arm. There was slow but steady decrease in the size of the tumor and immediate cessation of the pain, which had been constant from the first appearance of the tumor. The shell of bone about the tumor, which, as stated, had undergone spontaneous fracture, gradually became harder, with the formation of new bone, and within a few weeks complete union had occurred. The large cavity gradually filled up with granulations. Several curettements showed the material to be sarcoma of the same type as the original tumor, namely, spindle-celled. The pathological examinations were made by Dr. J. C. Bloodgood, of Johns Hopkins, and also by Dr. James Ewing, professor of pathology at Cornell University Medical School. Dr. Bloodgood regarded it as of the very malignant type of sarcoma which he characterized as "bone aneurysm."

Another *x*-ray examination in the latter part of 1910 showed that the new growth had apparently entirely disappeared and there was firm union of the arm. The patient's general condition was excellent. In November the granulations began to increase again in size, and in spite of curetting quickly recurred. An *x*-ray taken in December showed a small shadow starting in the periosteum, in the axillary region, and I finally decided, early in January, to do a shoulder-joint amputation.

Six months later there was a very extensive recurrence in the pectoral muscle the size of a closed fist. The tumor was removed,

but the operation was necessarily incomplete, and I had little hope of controlling the disease. The toxins, however, were immediately resumed, and the treatment persisted in for nearly six months longer. Since that time he has had no recurrence, and has remained in good health, working as a mechanical engineer ever since. A telegram received from him on April 8, 1914 (nearly four years later) stated that he was never in better health.

Another case of sarcoma of the humerus, successfully treated with the mixed toxins, with preservation of the limb as well as the life, is worthy of brief note:

A. C., female, aged thirty-one years, was operated upon by Dr. J. B. Blake, of Boston, in 1899, for sarcoma of the upper end of the humerus, involving the tip of the coracoid and part of the glenoid cavity of the scapula. It was impossible to make a thorough removal of the disease without a complete interscapulothoracic amputation. A very incomplete operation consisting in practically nothing more than curetting, was performed, and the patient treated as an inoperable case and put upon the mixed toxins of erysipelas and Bacillus prodigiosus, which were administered under my direction. The toxins were given three to four months immediately after the wound healed. The tumor entirely disappeared. Examination made by Dr. Blake on December 11, 1903, four years later, showed the patient to have gained ten pounds in weight; she was performing her regular work as housemaid. The motions of the shoulder (left) are anteroposterior, two-thirds normal; rotation, half normal; abduction to nearly 90 degrees beyond which point the elbow could not be raised.

Seven years later, in 1906, I personally showed the patient before the Surgical Section of the American Medical Association in Boston, and learned that she was in good health in 1913, fourteen years after treatment.

June 12, 1914. In accordance with a letter just received from Dr. Blake, the patient had a right cerebral hemorrhage about a year ago, which left her with an almost complete uni-

lateral paralysis. He states that he saw her at the time, but could find no trace of sarcoma anywhere.

The microscopic examination in this case was round-celled osteosarcoma of the humerus. Inasmuch as there are practically no cases on record of sarcoma of the humerus cured by operation, even after as extensive a procedure as interscapulothoracic amputation,[1] these two cases speak strongly in favor of the value of the toxins even in the most malignant types of sarcoma of the long bones.

Periosteal Sarcoma of the Right Femur. G. M., female, aged twenty-seven years. In May, 1912, first noticed pain in leg; began to lose weight. A diagnosis of periosteal sarcoma was made on the basis of the clinical history, physical and *x*-ray examination, and immediate amputation was advised but refused. Patient was referred to me in September, 1912, and entered the General Memorial Hospital for the toxin treatment. Measurements over upper, middle, and lower part of the tumor were as follows:

Right: 16 inches; $18\frac{1}{2}$ inches; $19\frac{1}{2}$ inches.

Left: $15\frac{1}{2}$ inches; $17\frac{1}{2}$ inches; $18\frac{1}{4}$ inches.

Wassermann reaction negative. I concurred in the diagnosis of periosteal sarcoma. At the end of a week I made an exploratory incision, removing a wedge-shaped portion of the tumor, which latter, clinically, had every appearance of a periosteal sarcoma originating in the shaft of the bone. The specimen was sent to Dr. Ewing, who reported as follows:

"September 28, 1912: The tissue shows very little if any specific process and does not permit of a diagnosis. There is infiltration of the vessels with large round cells, suggesting sarcoma, but which might very well be tuberculous. I ought not to express any opinion on the data received and I would not amputate without further information."

[1] Mr. Gask's statistical report of the results of operation in cases of sarcoma of the long bones observed at St. Bartholomew's Hospital, London, from 1902–11, shows not a single cure of sarcoma of the humerus.

The toxins were begun, the initial dose being 0.5 minim, which was carried up to 6 minims, injections being given four to five times a week. At the end of two weeks there was marked

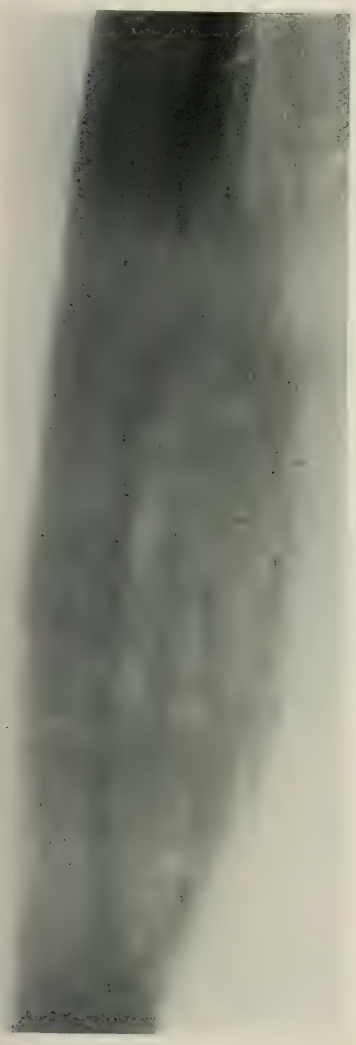

FIG. 8.—Case G. M. October, 1912. Periosteal sarcoma of femur. Clinical and *x*-ray diagnosis. Negative Wassermann.

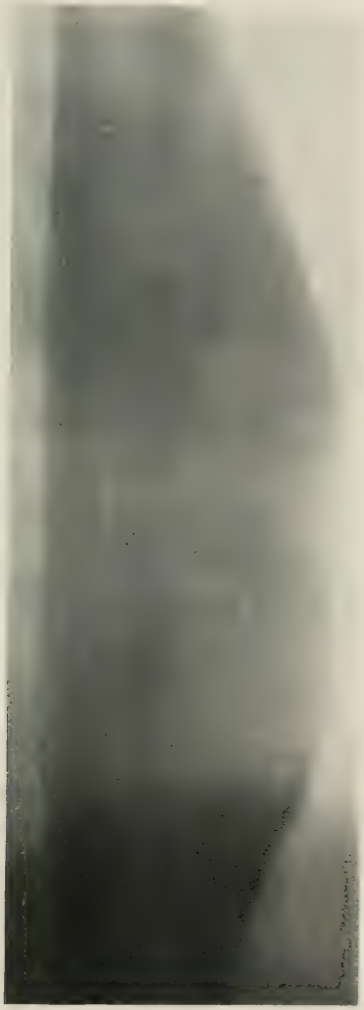

FIG. 9.—Case G. M. January, 1914.

diminution in the circumference of the thigh. In view of the lack of certainty in Dr. Ewing's diagnosis, and the rapid improve-

FIG. 10.—Case G. M. January, 1914.

ment under the toxin treatment, I decided on November 1 to make another exploratory incision. Clinically the tumor had

the appearance of a partially necrotic sarcoma. Dr. Ewing's report of this specimen reads:

"Five sections from five different parts of the tissue received fail to show any signs of sarcoma. There is suppurative inflammation in an area lined with granulation tissue. I find no signs of syphilis or tubercle. The condition suggests to me a pyogenic infection of the periosteum or osteomyelitis."

A number of *x*-ray photographs were taken by Drs. Cole and Holding, who believed the condition to be periosteal sarcoma. The tumor continued to decrease in size and at the end of six weeks the circumference of the thigh was nearly normal. The patient had gained ten pounds in weight. She returned home to have the toxins continued by her family physician. When I saw her again in January, 1913, the tumor had increased in size although her general health had remained good. Under larger and more frequent doses of the toxins the tumor again began to decrease in size. The toxins were kept up until the latter part of 1913, two to three times a week in doses up to 12 minims, which were followed by moderate reactions. All injections were given systemically. An *x*-ray photograph taken January 5, 1914, showed the density of the bone to have increased without any evidence of increase in size. As a sinus had persisted I determined to enlarge it to see if a piece of bone had not been the cause of its failure to heal. Microscopic examination by Dr. James Ewing (of the tissue removed) reads:

JANUARY 6, 1914.

"The tissues in the case of Mrs. M. fail to show any definite evidence of a tumor. They represent dense fibrous tissue, the vessels of which are sheathed by numerous plasma cells. It is possible that these cells are a derivative of a perforating marrow tumor of the type of multiple myeloma, but the appearance is more suggestive of chronic inflammation. The wall of the sinus is lined by cellular and edematous granulation tissue."

After this the sinus closed. The patient continued to gain in weight and was shown by me before the International Surgical

Congress in April, 1914, in perfect health, measurements of both thighs being the same.

The typical clinical picture at the beginning, the marked improvement under the toxins, followed by increased growth after the treatment was stopped, again followed by improvement on resumption of treatment and final recovery of normal health, leaves little ground for doubting the correctness of the clinical diagnosis of periosteal sarcoma, and the *x*-ray picture furnishes strong confirmatory evidence.

Were there no other cases of periosteal sarcoma on record in which a similar result had occurred, the diagnosis could not be accepted too implicitly without confirmation by microscopic examination. However, in Case V a much larger periosteal tumor of the femur, with extensive metastases, did completely disappear under the toxins, and the patient remained well for ten years. In this case the diagnosis was confirmed by microscopic examination made by Dr. F. K. Dunham, professor of pathology at Bellevue University Medical School, and Dr. B. R. Buxton.

At the discussion of the Royal Society in 1913, Sir Frederick Eve touched briefly upon the question of the use of the toxins in sarcoma of the long bones. He stated that he had not been convinced of their value as a prophylactic after amputation. His opinion was based upon a comparatively limited experience at the London Hospital at which institution the toxins had been tried in ten cases. Five of these were periosteal sarcoma, and it is worthy of note that the only case of the latter in which the patient survived the operation over two years, was one in which the toxins had been thoroughly tried before amputation. At the time of the report, that patient was in good health and free from recurrence two years and seven months later.

That the toxins may materially alter the malignancy of the tumor, without destroying it altogether, is illustrated by one of my own cases, a very rapidly growing and extensive periosteal sarcoma involving the upper two-thirds of the femur, which I regarded entirely beyond hip-joint amputation. The toxins

were given for a period of four months. At first there was some diminution in size, but later no further beneficial effect was noticeable. The patient returned home and later a hip-joint amputation was done at another hospital. This patient was alive and in good health when I last heard from him, one and one-half years thereafter.

The most conclusive evidence of the value of the mixed toxins in periosteal sarcoma of the long bones, is furnished I believe by the case reported in full detail before the American Surgical Association a year ago.[1] It is sufficient here to state that the patient, A. G., male, aged nineteen years, had a very large periosteal round-celled sarcoma involving two-thirds of the shaft of the femur, with very extensive metastases in the pectoral and iliolumbar regions. The case was regarded as hopeless. Prolonged *x*-ray treatment had been used upon the tumor in the femur (February, 1902). Also some *x*-rays were used in the pectoral region after the tumor had been partially excised, but no *x*-rays were used on the very large iliolumbar tumor involving the ilium. This disappeared under the toxin treatment alone, and the boy remained perfectly well for ten years, when he developed a rapidly growing tumor at the site of the old *x*-ray dermatitis of the thigh, which tumor proved to be partly round-celled sarcoma and partly epithelioma originating in the soft parts, but not the bone; it proved highly malignant, causing death from metastasis shortly after the operation. In concluding I may repeat what I have said in a previous paper.

"In view of these results I think we are justified in giving up the traditional method of treating all cases of sarcoma of the long bones by immediate amputation. In most cases I believe it safe to wait for two or three weeks, the time required for a trial with the toxins, before sacrificing the limb. Sarcoma cases of extremely rapid growth will probably show little or no effect from the toxins, and one might naturally say valuable

[1] Transactions of the American Surgical Association, 1913, and Annals of Surgery, July, 1913.

time had been lost by the preliminary use of the toxins. It is my opinion, however, that early operation in these cases would not have been of the slightest avail, as shown by the long, almost unbroken list of recurrences and deaths in cases treated by operation alone. On the other hand, in certain cases—probably a small number—the limb will be saved by the preliminary use of the toxins. In those in which early improvement is not marked, operation can then be performed with even greater chances of ultimate success than if the toxins had not been first used.

"The greatest value of the toxins in sarcoma of the long bones will, I believe, be shown to lie in a judicious combination with conservative operative treatment. By such procedure a hip-joint amputation, which has been the almost uniform rule for sarcoma of the femur, will give place to an amputation below the trochanter, which will leave a stump of sufficient length to permit the wearing of an artificial limb, and this is no small gain. The toxins will be administered for a considerable period of time after amputation with the hope of destroying the cells which are left behind and which, with operative treatment alone, cause the local and metastatic recurrences. The same rules will apply to sarcoma of the humerus.

"Coming to sarcoma of the tibia, fibula, radius, and ulna, particularly of the myeloid type, in place of amputation, as formerly advised and still advocated by the great majority of surgeons, we can safely substitute either curetting or partial resection, followed by a thorough course of the mixed toxins. While good results have been obtained from operation alone in a very limited number of cases in this group, I am convinced that the number of successes will be greatly increased by combining the toxin treatment with conservative operation, as I have suggested, and my series of cases strongly supports this opinion."

Summary. The chief requirements for the early diagnosis of sarcoma of the long bones may be summarized as follows:

1. A more careful study of all known clinical data.

2. A larger clinical experience in the diagnosis of sarcoma of the long bones.

3. Early and repeated *x*-ray examinations in all cases of suspected swellings of the long bones, especially those following trauma.

4. Exploratory operation and microscopic examination of the tissue removed in selected cases, but *not* as a routine measure.

5. Realization of the importance of not placing implicit reliance upon the negative report of the pathologist, especially when in conflict with clinical and *x*-ray evidence that is strongly positive.

DISCUSSION

Dr. C. A. Porter, Boston.

I would like to mention a case of giant-celled sarcoma of the upper lumbar vertebræ in a boy of nineteen. The preoperative diagnosis was a deep tuberculous abscess. On incising through the erector spinæ a tremendously vascular soft tumor was found, which was curetted with excessive hemorrhage. This was controlled finally by firm gauze packing. The tumor was found to originate from the lumbar vertebræ bodies and laminæ. The wound was packed. Pathological examination showed a typical giant-celled sarcoma. The patient was at once put upon large doses of Coley's toxins by Dr. Harmer. There was a recurrence, with some spinal symptoms after three months, but under treatment the tumor entirely disappeared, and the boy is now, so far as we can tell, perfectly well, two years after operation.

Dr. John H. Gibbon, Philadelphia.

For many years I was disappointed in my experience with the toxins, probably because of the way in which they were used, but I have changed my opinion, owing to later experience. I have had one case of periosteal spindle-celled sarcoma in a girl, aged seventeen years; prompt recurrence after incomplete operation; refusal of shoulder-joint amputation. She was then given the toxins and *x*-rays. It has now been five years, with absolute recovery and absolutely no evidence of recurrence. She has since married and borne a child.

Last summer, at the Pennsylvania Hospital, my assistant, Dr. Allen, operated for a recurrent spindle-celled sarcoma of the forearm in another patient. Prompt recurrence taking place, the patient was put on the toxins and *x*-ray treatment. The growth melted under it, and at the present time, eight or nine months since it was started, there is no evidence of recurrence. This patient has been discharged from the hospital, and although he cannot be said to be cured, yet he has followed so far the example of the first case cited, and therefore I feel differently about the toxins now than I did six or eight years ago. I use them in every case of inoperable sarcoma, and believe I am justified in this procedure even though my successful experience is as yet limited to but two cases. Lately, since the above report was made, the second case has shown a small recurrence and is again taking the toxins.

Dr. T. W. Huntington, San Francisco.

With many discouragements and disappointments in connection with this work, I have followed faithfully Dr. Coley's method. After a considerable experience I am able to report 2 cases which have been altogether encouraging. For these patients I began with infinitesimal doses.

In one instance this was done after total excision of the clavicle, and the patient is well six or seven years after operation. The treatment extended over six months.

Objection may be raised that the operation cured the patient, but I feel that the effort was well worth while.

The second case was almost phenomenal. A large spindle-celled sarcoma followed the kick of a horse after six months. The growth was located in the muscles of the right thigh. The tumor was removed by a physician in the country, but it recurred immediately.

Two months later I did a very extensive operation, cleaning out the entire side of the thigh. The patient was then placed on very small doses of the toxins, the dose being gradually increased to the point of tolerance. The treatment was continued for six months, and the patient is now well, after one year. His condition is satisfactory in every respect.

Dr. Archibald MacLaren, St. Paul.

I started rather the opposite way from the other men who have discussed this paper. My partner, Dr. T. De Witt, had studied with Dr. Coley and was well acquainted with his technique. From a case of erysipelas he grew his own bacteria, and manufactured his own toxins, and after injecting them obtained one real result. This was a case of partial removal of a spindle-celled sarcoma of the parotid treated by the toxins as above; the tumor recurred inside of a year. Under the toxins the growth entirely disappeared; again a return, which disappeared after an ordinary attack of typhoid fever. In five years the woman died with general sarcomatosis, so that the original condition must have been sarcoma. There is no question that the growth disappeared after typhoid fever, nor is there any question of its complete disappearance under the administration of the toxins.

In my later experience with a large number of malignant cases, including a few spindle-celled sarcomata there were practically no results.

Dr. Howard Lilienthal, New York.

Coley's toxins have been employed by me consistently up to the present time. Although I have noted the actual disappearance

and cure of malignant growths in but two instances, I feel that even that was well worth while. For many years I have used the toxins regularly as a postoperative treatment following surgical work in cases of sarcoma, and I have also used the toxins in a number of cases of carcinoma. My impression is that recurrences have been diminished by this form of treatment.

Referring to the 2 actual cases, I will briefly state that one patient, whose case has been reported at various times, was a man operated upon for cystic sarcoma of the ribs involving the pleura, and that although no attempt was made to remove the entire growth, it disappeared following Coley's toxin treatment. The man is alive and well now, about thirteen years after his operation. The second case was that of a young woman who had an osteosarcoma of the upper jaw, which was also only partially removed, a bony nodule being left in the nasal region, and much soft sarcomatous tissue being also left behind in the neighborhood of the nose. The diagnosis was made at the pathological laboratory of Mt. Sinai Hospital. The bony nodules referred to disappeared about three weeks following the beginning of the toxin treatment, and the patient is now absolutely well, more than a year after the operation. The first case was reported as containing pigmented elements, and the pathologist gave a bad prognosis.

Dr. William L. Rodman, Philadelphia.

I have had no case of recovery after the use of the toxins in sarcoma of the long bones; I have, however, one complete recovery after the use of the toxins in sarcoma of the throat, and another favorable recovery in sarcoma of the parotid gland. The most marked effect I have ever seen was in a patient of a former colleague in Louisville, Kentucky, Dr. Coomes, who had operated five or six times on a young man, aged twenty years, the growth promptly recurring after each operation. He asked me to see the case in consultation. I suggested the use of the toxins and furnished him with the preparation. It was used for weeks or months and to my surprise and gratification, when I saw Dr. Coomes, six weeks ago, he told me that this young man had since studied medicine, was now a practising physician, and was entirely well in every way. This case occurred sixteen years ago.

Another case of sarcoma of the parotid was twice operated on by a surgeon in New York City, the patient being the wife of a naval officer. She later came to Philadelphia and fell under my care. After seeing the patient I told her just what her surgeon in New York had said, that a third operation would be more extensive than the

first two, and would almost necessitate paralysis of the face. She therefore declined it. I used the toxins with a complete disappearance of the growth, and so far as I know she is well at this time.

I have seen many other cases markedly improved, and had the treatment been persistently carried out thorough and complete cures might have resulted in some of them. I would refer to one case, the late Dr. H., of Shelbyville, Kentucky. His pelvis was absolutely blocked with sarcoma. He came to New York and Dr. Coley used the toxins, and when he returned to Kentucky he was, so I am informed, almost entirely relieved. He was anxious to return home, believing he could keep up the treatment. However, soon afterward the growth returned and he died.

Like Dr. Lilienthal and others, I have faith in the toxins and think we should always use them in inoperable sarcoma. I have not seen any good results from their use in carcinoma.

Dr. N. B. Carson, St. Louis.

Many years ago a case came to me with a tumor under the clavicle, which I thought was connected with the clavicle. The patient had been operated on and the diagnosis given was sarcoma. She refused a second operation, and we used the Coley toxins. This tumor disappeared gradually and I was enabled to follow the patient for a number of years afterward, and there was no return the last time I heard from her. I do not know whether she is still living.

Another interesting case occurred in the practice of a colleague of mine, in which the whole lower abdomen was filled with what was taken to be a sarcoma. Coley toxins were given; this tumor gradually disappeared, and I heard from the patient three years after the time, and she was still well.

I have at present a case of a young doctor, aged thirty years, who had a sarcoma of the humerus, which had been operated on just before I saw him, and which had recurred. The infection had involved the shoulder. I did a second operation and have been using the Coley toxins since. On the anniversary of the operation the doctor wrote me he was happy, had never felt better, was doing a large practice, and was still perfectly well.

I wish to say further that I have used the Coley toxins several times in sarcoma without success, and frequently in carcinoma with no success whatever.

Dr. Willy Meyer, New York.

Having Dr. Coley in New York it is quite natural that we send our private patients to him for treatment, but we have at our hospital,

at least in my division, also adopted the rule of sending our ward patients to him for admission to the General Memorial Hospital. Therefore my personal observation only refers to private patients in consultation.

I would first say that the point mentioned by many speakers of the Coley toxins having no effect in carcinoma is substantiated; neither did I see it have any effect in endothelioma. It has been my misfortune to have had two male patients who had small tumors on the back simulating atheroma. One was operated by a colleague under local anesthesia in which there was great trouble in finishing; in the other case, operated upon by myself, microscopic examination also proved the condition to be endothelioma. The latter was found on a patient, a man, who had at the same time a scirrhus of the breast. Both cases proved to be extremely malignant. In these cases the toxins had no effect.

A few months ago I saw a patient, a doctor, in Rochester, with sarcoma of the anterior mediastinum, who came three months later to New York. He showed all the typical symptoms of such a tumor, great pains in the arms, compression of veins, etc. He insisted on thoracotomy to see what could be done by operation. I prevailed on him not to submit to that and asked him to go first to see Dr. Coley. After more or less discouragement on account of fever and chills, he again asked me for operation. I insisted on his staying with Dr. Coley. The latter not long ago told me that this patient had written him that he was now so much better he wanted to continue the treatment at his own home.

There is no doubt that sarcoma, and particularly inoperable sarcoma, needs the Coley toxins beside the *x*-ray treatment, and often can be much benefited or cured by them.

Dr. Stanley Stillman, San Francisco.

Many years ago I had a case of sarcoma in the chest wall in an Italian, who attributed it to the irritation produced by leaning over the gunwale of a boat, he being a fisherman. He was given the Coley toxins and the tumor entirely disappeared. The man, however, did not recover. He had extensive mediastinal metastasis, and died just as we thought he was getting well; the parent growth entirely disappeared.

I think it is important, in connection with Dr. Coley's paper, to remember that periosteal sarcomata are very rarely recovered from. In my own experience of 4 or 6 cases none ever recovered. The cases that were amputated or disarticulated without the use of the Coley

toxins died generally within one year, or at the outside, in two years. Dr. Coley has reported a number of cases now living, after eight or more years, and I think that is one of the most important facts brought forward in connection with his toxins, that after amputation the use of them may result in recovery, when without them recurrence is almost inevitable.

Dr. Charles H. Peck, New York.

I would like to add the report of 1 case of incompletely removed sarcoma of the submaxillary region, operated on five years ago, which was treated afterward with the Coley toxins and was followed by a complete cure. This patient is well today. It was an infiltrating round-celled sarcoma, and sections were made by the late Dr. Hodenpyl. They have been gone over since by others with the same report of sarcoma. There was no secondary growth. The growth involved the periosteum of the inferior maxilla, and the fact of the incomplete removal was unquestionable. Some of the growth was curetted away, but no attempt made to follow it, in the belief that it was too extensive to offer any hope whatever of cure. The operation was witnessed by Dr. MacKenzie and Dr. Freeman.

I have used the toxins in a number of cases, but this is the only case with beneficial results.

Dr. John B. Murphy, Chicago.

To say what I really believe of the clinical results of Dr. Coley's treatment would not be proper on this occasion. What I feel is that we are indebted to Dr. Coley not for the clinical results that have been obtained, because they have been colossally disappointing, but for keeping alive an element of hope by showing that there is something that we do not understand that does occasionally produce an alteration in the clinical course and brings a good result; true, in a small percentage of cases, but still brings it. It seems to me that when we look over the history of sarcoma we find many things that have influenced cases that were positively microscopically sarcomatous and still have recovered, and that Dr. Coley has kept to a system and that this system shows that something produces a change in the cells. The one that looks most likely to me is the effect that it has on the specific protoplasm of the cells. Now we have learned from Abderhalden that the protoplasm of each individual cell induces a specific enzyme and that this enzyme has a specific dialytic effect in the blood. That seems to be in line with the results which Dr. Coley has obtained by his splendid and admirable work for many

years in this rather discouraging field. His results have been the best obtained from a clinical stand-point up to this time, and let us hope that by some slight deviation from his present method, either of administration or vaccine production, a larger percentage of cures may be effected.

Dr. Arthur Dean Bevan, Chicago.

I should like to state very briefly my own impressions of this work. I have been very much interested in it. I want to remind you of the fact that the very first thing Fehleisen did when he demonstrated the streptococcus of erysipelas was to use it in pure culture in cases of malignant disease. That was done because before the demonstration of the streptococcus of erysipelas there had grown in the literature a large number of cases of malignancy that had been modified by various lesions, infections of various kinds, particularly erysipelas. I can remember very well my professor of surgery, Moses Gunn, one of the founders of the American Surgical Association, telling us that he had been impressed with the fact that in many of his operations for malignant disease an attack of erysipelas had seemed to give to the patient a certain immunity against recurrence, and that was a well-established theory accepted by many surgeons at that time. Fehleisen's early work with the streptococcus of erysipelas was too fatal—he killed too many patients. The reports, so far as the results were concerned, were encouraging in cases of acute erysipelas developing in sarcoma patients. The fatalities, however, caused a discontinuance of the treatment. He then used the toxin instead of the pure culture.

I think Dr. Coley is entitled to a great deal of credit, and I want to second very emphatically Dr. Murphy's statement to this effect, that he has persistently and for years carried on this work and placed it upon a thorough-going basis. And I am quite prepared to say and to accept the fact that in the course of thousands of cases a limited small number, which if all of the cases are taken into consideration, amount to a considerable number, but a small percentage, have been influenced by the use of the toxins. I think, however, that the important thing for us to determine is as to the possibilities of this treatment in malignant disease. Personally, I have had considerable experience, 75 to 100 cases, and I have never seen a cure from the use of the toxins in either carcinoma or in sarcoma. I have seen marked effects. I have used it and continue to do so, in inoperable cases, and I should put about this estimate from my own personal experience, that in a very limited percentage of cases the toxins affect malignant disease,

especially sarcoma, and produce a marked diminution in some cases. I am quite prepared to accept that in some cases the effect is sufficient to cure the patient. I want to say that I believe it is quite proper to use the erysipelas toxins if we have this estimate of its possibilities: That it gives to the patient a small possibility of benefit. I would like to emphasize that in my own experience the *x*-rays have been of very much more benefit in both inoperable carcinoma and sarcoma than have the toxins, and I believe that both should be employed, but with the estimate put on the toxins, that they simply give a possibility, not any great assurance, of benefit.

Dr. Charles F. Stokes, Washington.

Some thirteen or fourteen years ago a distant relative had an appendectomy performed which was followed by a persistent sinus where a sarcoma developed later on. The patient lived in San Francisco while I was stationed in New York, where I was communicated with, and suggested the use of Dr. Coley's toxins, having been more or less familiar with their beneficent effect in some cases as shown by him some years before at the New York Surgical Society.

A telegraphic reply informed me that the patient was in the hands of Dr. Fehleisen whom, as we know, discovered the erysipelas coccus and used it in pure culture with disastrous results in certain cases of malignant growth; naturally he did not approve of the method of treatment suggested by me, which of course is quite different from his early efforts of effecting amelioration or cure in these cases. This statement is simply made as an interesting incident in connection with sarcoma and the Coley toxins.

Dr. William J. Mayo, Rochester, Minnesota.

I think the Association is to be heartily congratulated on having a Fellow with the courage of Dr. Coley to carry this thing along to the present time under the very great discouragements that have existed.

Dr. William B. Coley, New York (in closing).

I had little idea that my paper would provoke such a lengthy discussion, and, much less, such a favorable one. Dr. Murphy and Dr. Mayo have referred to the serious discouragements experienced during these twenty years, but no one could see the cases that I have seen, quite hopeless, inoperable sarcomas which disappeared under the use of the mixed toxins, without believing that there was something valuable in the treatment, and with this belief I would

not have been true to myself had I not continued the work. I want to acknowledge the inspiration which I have received in this work from Dr. Welch, Dr. Gerster, Dr. Mayo, Dr. Lilienthal, and other members of this Association.

I should like to say a few words about Dr. Gibbon's case of sarcoma of the humerus, which, together with my own cases of sarcoma of the humerus, goes a long way in proving the value of the toxins, especially inasmuch as this type of tumor is extremely malignant, there being practically no cases on record of cure from surgery.

Dr. Lilienthal has reported the only case of melanotic sarcoma cured by the toxins in this country, although Dr. Greenwood, of Leeds, England, has also reported a successful case of this type, a full history of which appeared in the London *Lancet*, January 19, 1912. In the latter case the patient has remained well over three years, while Dr. Lilenthal's case has now been well over ten years. I will not go into detail with regard to the early experiments with the living streptococcus of erysipelas; the dangers and uncertainties of which method, led me to substitute the toxins for the living germ. While it is impossible to give the exact percentage of cures obtained by my method in the hands of other men, I will say that personally I have treated 715 cases of inoperable sarcoma, of which a little over 80 were successful. Of these, 52 have remained well from three to twenty years, and to those of you who are sufficiently interested in the subject I propose to give a clinic on Saturday afternoon at the General Memorial Hospital, at which time I will show you twenty patients who have remained well from three to twenty years after the treatment. The diagnosis in these cases was established beyond question, and the patients are all now in good health. I believe by far the greatest value of the toxins lies in using them as a prophylactic measure after operation, as best demonstrated by my cases of sarcoma of the long bones, particularly the periosteal type.

SYSTEMIC BLASTOMYCOSIS

By CHARLES A. POWERS, M.D.
DENVER, COL.

The knowledge of the fact that yeasts may act as pathogenic agents dates from the year 1890 when Grohe[3] reported to the Greifswald Medical Society the result of experiments made by him with mould and yeast fungi injected into the blood or peritoneum of animals. These animals usually died shortly after injection. In 1892 Popoff[4] employed ordinary commercial compressed yeast which was cut into small pieces, dried, ground to a powder, strained through a towel and injected into the blood-vessels, beneath the skin, and into the thoracic cavity of dogs. The animals usually died within a few hours or days, with septic phenomena. Popoff often noted the appearance of nodules, resembling tubercles, in the kidneys, spleen, and lungs. Microscopically these nodules were found to contain yeast cells and starch granules. The above named experiments were made with impure material and were therefore hardly considered convincing.

The first article carrying fair conviction regarding the problem of pathogenic yeast was published by Raum,[5] who injected several kinds of yeasts into rabbits, apparently observing localization and growth of these microörganisms in the animal body.

In 1893 Tokishige,[6] Professor at the Tokio Veterinary Academy, described an endemic disease of horses in Japan in which a fission fungus was found to be so abundant, that after prolonged microscopic examination, he believed himself justified in regarding it as the cause of the disease. This report attracted but little attention even from the veterinarians.

Busse[7] and Buschke,[8] in 1894, reported in detail a case which

came under their observation in the surgical clinic at Greifswald. Shortly thereafter, and independently, Gilchrist[9] reported a case of skin disease, supposed to be due to yeasts, in man. However, in view of the fact that he made no cultures, his observation is hardly to be regarded as convincing. Busse would accordingly seem to be entitled to the credit of having been the first to make clear observations.

In a general way it may be said that the disease in animals, appearing in epidemics, is relatively benign in character. Many animals get well, while the majority of the fatal cases seem to succumb to exhaustion through the superficial distribution of the process rather than through its penetrating to the viscera. Buschke considers the avenue of entrance as ordinarily occurring through the skin, whence, in man, it is carried into the interior of the body. As far as he is able to ascertain, the distribution takes place by way of the lymph-channels through which the fungi reach the lymph-glands. In the rarer cases of retrogression of the local disease a subsidence of the pathological process can also be noted in the lymph-glands. For further and extensive account of the pathological process the reader is referred to this valuable and instructive article by Buschke.

In systemic blastomycosis, as well as in the cutaneous form, the most common change is represented by a simple mycosis. Proliferation processes may develop in the affected tissue much as they do in the so-called infectious granulomata.

An instructive communication was made in 1910 by Franchetti and Cazzaniga,[18] who believed themselves justified, on the basis of cases described in literature, of personal experimentation and the experiments of others, in coming to the conclusion that yeast microörganisms undoubtedly possess pathogenic properties, although this particular family of fungi is very large and the group is still obscure.

As regards the clinical course of infectious blastomycosis, experimental findings serve to confirm the results of clinical observations. The course is usually slow, anemia is present, there is generally progressive emaciation. Albuminuria is frequent

and the end is almost always fatal in the severe general infections and in the forms with localization in the nervous system. Any or practically all of the tissues of the body may be affected.

Two cases of systemic blastomycosis, both fatal, have come under my observation. The first was a man of forty-four years who gave the following history: He suffered from pneumonia at 19 years of age, while at the age of 23 years he had a bronchial cough which lasted for one year. Two years later this cough returned and continued for one year when he went to the Adirondacks, living there for about six months. He had had no subsequent chest trouble. At 32 years of age he noticed two small, soft lumps in the lower part of the neck, one above each collarbone. These gradually enlarged and were removed 15 months later. No microscopical examination seems to have been made; the sinuses healed slowly.

In 1902 two small, hard nodules, each about the size of a pea, appeared in the lower part of the neck in the median line and were removed. One year later another nodule was removed. At this time the general health was considerably below par.

In the latter part of 1903 he went to South Carolina where the general condition tended to improve. At about this time another lump appeared but it gradually subsided. This lump reappeared six months later and was taken out. In 1906, while in Europe, he suffered attacks of indigestion and jaundice, these attacks lasting two or three months. From this time, 1906, until the autumn of 1910, his general condition remained fairly good. He spent the winter of 1910-11 in California and during these winter months many lumps appeared below the lower jaw on each side. He passed the spring of 1911 in Arizona, coming to Denver in June, at which time I found the entire neck below the lower jaw, on each side, filled with hardish lumps and presenting multiple sinuses. The general condition was much impaired. I cleared the neck thoroughly on each side but through some unfortunate error, possibly owing to the fact that I was leaving town, the tissues were not histologically examined. My own clinical diagnosis was tuberculosis. Two or three weeks after

this operation upon the neck small, soft lumps appeared on the abdomen and thighs beneath the skin. These were opened, discharging pus, and healing rather slowly.

In August, 1911, evidence of disease of the two last dorsal vertebræ was found, both on examination and by the *x*-ray.

In October, 1911, on my return from Europe, I opened a number of moderate sized abscesses on the back, thighs, and right hand. Cultures from these abscesses gave pure blastomycosis. From time to time other abscesses appeared in different parts of the body and on being opened showed, on culture, the same microörganism. Thoracic and abdominal symptoms came on and from August, 1911, the patient's health gradually failed. Management rested on general tonics, the best possible attention to the general health, and on the occasional employment of potassium iodide and cupric sulphate. These latter drugs were not well borne and he died from exhaustion April 20, 1912. Autopsy was made by Dr. Ross C. Whitman, professor of pathology in the University of Colorado. Dr. Whitman's report is as follows:

Pathological Diagnosis. Sinuses angle of left jaw, right side of neck above clavicle, extensor surface right thumb and on back. Six openings at various levels either side of spinal column, and one on inner aspect left thigh. Emaciation. Multiple miliary abscesses of liver; 2 miliary abscesses spleen; caries thoracic spine; iliopsoas abscess (moderate size, not prominent); miliary abscess pelvis left kidney; nephritis (?); acute, fibrinous, left-sided pleurisy with exudate. Destruction lower lobe left lung.

Dr. Whitman further reports: "The lesions found macroscopically in bone, liver, pleura and submaxillary lymph-nodes, as well as the microscopic lesions found in the spleen, are everywhere essentially alike, the differences being apparently due in part to the stage of development of the individual lesion, and in part to the physical conditions, as in the pleura, where the character of the serous membrane and friction have somewhat modified the picture. The main features of the disease process can be reconstructed in considerable detail.

"The organism lodges first in a small vessel or capillary. The endothelial cells proliferate, becoming larger and plumper, and separate from the wall. Later they may fuse about the organism to form a typical giant-cell of the Langhans type. The vessel is occluded, and the vessel wall disappears, leaving a collection of endothelial cells. This enlarges, encroaching on the surrounding parenchyma, which disappears, leaving a supporting connective tissue stroma and capsule. The connective tissue also increases to some extent, and may organize the lesion, replacing

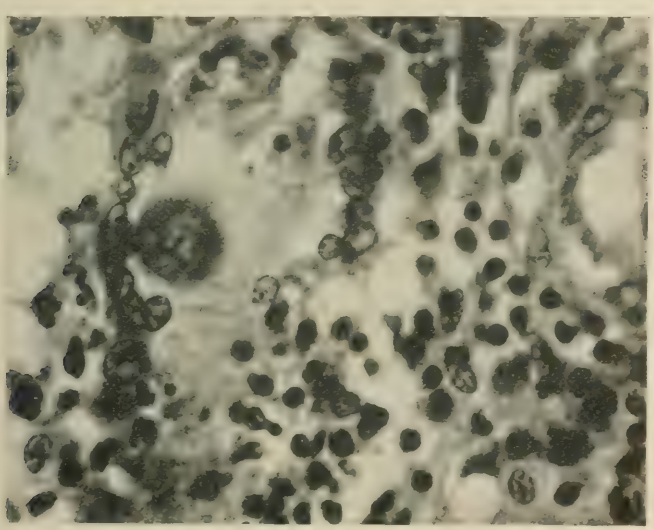

FIG. 1.—Zeiss apo. obj. 2 mm. oil immersion, comp. oc. No. 8. Intravascular formation of giant cells about a blastomyces.

it by scar tissue. In the earlier stages of the lesion there is more or less infiltration by leukocytes among which plasma cells and eosinophilic myelocytes are a striking feature, which serve at once to distinguish the process from tuberculosis. Somewhat later the cells of the lesion undergo a wide-spread and uniform coagulation necrosis, similar to the type commonly met with in rapidly growing malignant tumors, and differing from caseation in the fact that the structure of the cells can be recognized for some time after necrosis has taken place. Lesions as large as

1 to 2 cm. in diameter may consist of a capsule surrounded by a narrow zone of leukocytes and small daughter lesions, and con-

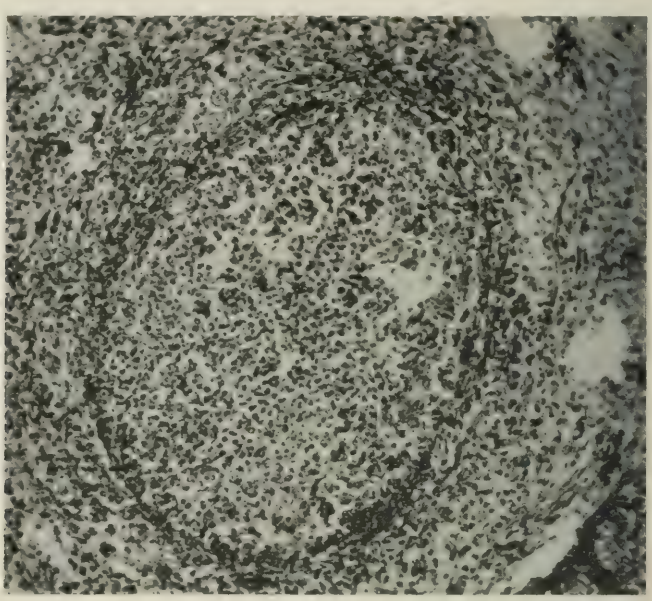

FIG. 2.—Zeiss apo. obj. 16 mm. without ocular. Small granuloma from pleura, consisting of a collection of endothelial leukocytes (endothelioid cells). The wall in this case consists of fibrin.

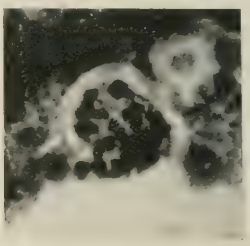

FIG. 3.—Zeiss apo. obj. 2 mm., comp. oc. No. 4. Blastomyces showing endosporulation (ascus formation).

taining a pasty mass of necrotic cells with little or no living tissue. Ultimately, the dead tissue is extensively infiltrated by polymorphonuclear neutrophiles, the disintegration of which, with

the resulting liberation of proteolytic ferments, is doubtless responsible for the liquefaction which occurs.

"The process in the pleura is modified by the pouring out of a profuse fibrinous exudate in which abundant pus cells are found. Apparently there has been no tendency to walling off, the exudate having spread uniformly over the entire serous membrane.

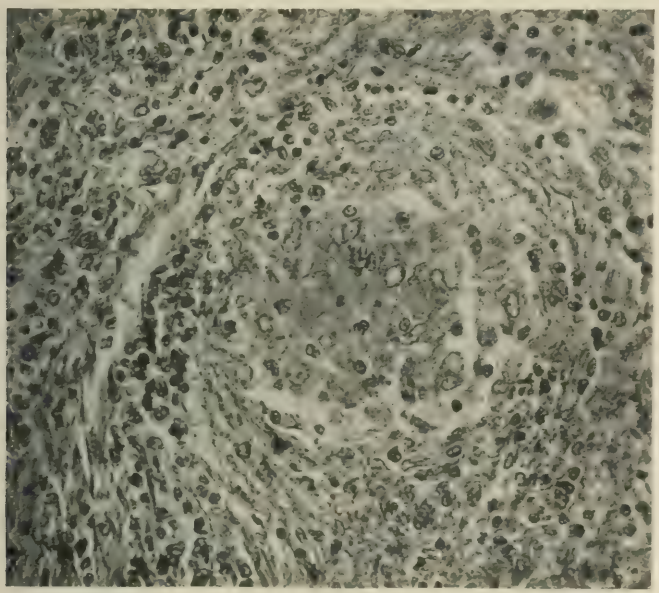

FIG. 4.—Magnification as in Fig. 3. Small lesion from spleen. Group of endothelial cells, with beginning necrobiosis and infiltration of polymorphonuclear leukocytes.

"The organism is found fairly abundantly in all the lesions. It was described in some detail by myself in a paper published last summer (*Journal Infectious Diseases*, vol. xiii, p. 85, 1914). It will suffice here to call attention to the fact that unquestionable budding forms are not found. Multiplication seems to take place only by endosporulation; which in the paper above mentioned is interpreted as ascus formation. I can but think that the original condition in this case was blastomycosis."

My second case was observed some years ago and in its main features followed the course of the one just narrated, excepting that the original focus was a nodule at the back of the left hand, which nodule had undergone suppuration and curetting some three years before the patient came under my observation. The case terminated fatally with thoracic, abdominal, and joint lesions. The histology and bacteriology were carefully studied and reported upon by Dr. J. A. Wilder, at that time professor of pathology in the University of Denver.

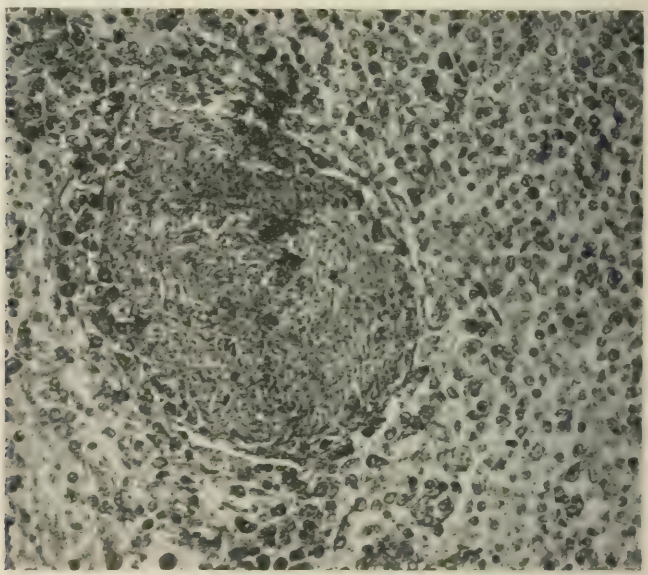

FIG. 5.—Magnification as above. Lesion from spleen showing early fibrosis.

The literature upon this subject is abundant and need not be reproduced here. The central thought in my mind is that the systemic form of blastomycosis is almost invariably fatal and that this grave condition generally begins in a small local focus. I believe that such local focus or foci should be very widely excised as early as possible, in order to attempt to forestall dissemination.

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DISCUSSION

Dr. MacNeal, New York.

The material came to us at first in the fall of 1911 and a diagnosis of tuberculosis was made on histological examination. Later on further material was sent by Dr. Powers with the information that Dr. Whitman had established a diagnosis of blastomycosis.

We therefore made further search and recognized that this was not an ordinary type of blastomycosis, but was an unusual one, distinguished by the fact that the parasite reproduces not by budding but by endogenous spore formation. About twenty-four cases have so far been recorded with only two recoveries. In one instance the limb was amputated while the disease was localized in the thigh; and the other is a case reported by Wolbach in which thorough surgical treatment obliterated the disease. The character of the microörganism as it exists in the tissue and as it grows differs from the ordinary blastomyces.

Dr. Arthur Dean Bevan, Chicago.

I would like to say that very shortly after Gilchrist announced his first case of this disease I had the opportunity of seeing a case which was reported in the literature as the Hektoen-Hyde-Bevan case, at which time there were only two or three in the literature. It was interesting from this standpoint: Dr. Hyde, the dermatologist, referred it to me as a surgeon to extirpate the lesion, with the understanding that he was uncertain whether it was tuberculosis or syphilis. I extirpated an extensive lesion in the arm, submitted it to Dr. Hektoen, and he isolated the yeast fungus. After the organism was demonstrated I tried a series of experiments on this particular case with three drugs, bichloride of mercury internally with no effect, then potassium iodide with marked effect. Very shortly after giving the potassium iodide an extensive lesion cleared up almost entirely quite as readily as we find a gumma disappearing under the iodide. We found, however, in a considerable series of cases that this was not always true, but that this drug had a marked effect on the organism. Later we used copper, and we thought for a time with pretty marked effect, and I still think with some effect. My colleague, Dr. Ormsby, has collected from the literature one hundred cases, and about twenty cases of systemic blastomycosis, which he has actually seen, and in which he has obtained a number of postmortems. A number of other men have seen a large series of these cases.

I want to emphasize that these cases are more frequent than is

generally recognized. The Germans do not know anything about blastomycosis, and for a long time doubted the existence of this lesion, but it is quite as definite a lesion as syphilis or tuberculosis. I have personally been interested in the treatment and want to emphasize that it rests on the use of potassium iodide plus the use of the *x*-ray. In the local cases nearly all are cured with potassium iodide and the *x*-ray. I do not believe that so far any of the systemic cases under the observation of Dr. Ormsby and myself and others have gone on to recovery.

Dr. N. B. Carson, St. Louis.

Sometime ago we seemed to have an epidemic of blastomycosis in St. Louis and two or three of the cases were of the systemic type, all of which died. What is more, they seemed to tolerate drugs very badly. We gave them potassium iodide in varying doses, and it was not tolerated at all. We tried different forms of treatment, and in the local cases with very good success; but so far as the general cases are concerned I think they all went to the grave. We had quite a number of observations made at the Barnard Free Skin and Cancer Hospital, with some very interesting results.

Dr. Emmet Rixford, San Francisco.

It is questionable whether the term blastomycosis should be extended to include cases of infection with fungi which multiply not by budding but by endogenous sporulation. The case of Hyde, Hektoen, and Bevan referred to were typical of true blastomycosis, *i. e.*, of the disease produced by budding fungi, but the case here reported by Dr. Powers and Dr. MacNeal is identical with the members of a group of some thirty cases caused by spherical spore-forming organisms with highly refractile capsule, and which, with the single exception of an isolated case reported by Wernicke in Monte Video in 1892 (case of Posadas), have thus far been limited to California and have nearly all occurred in patients who have lived in the San Joaquin Valley. It would be interesting to learn whether Dr. Powers' patient had gotten his infection elsewhere than in California.

The first two in California were found by me and reported in the *Occidental Medical Times* in 1894 under the title "Protozoic Dermatitis," I believing that the spherical organisms were protozoa allied to the coccidia. I sent some of the material to Dr. Welch, of Johns Hopkins Hospital, who gave it to Dr. Gilchrist for study. A joint report was published in 1896 in the *Johns Hopkins Hospital Reports* under the title "Two Cases of Protozoan Infection of the

Skin and Other Organs." Dr. Stiles, of Washington, an authority on protozoa, suggested the name Coccidioides Immitis for the organism, and most of the cases subsequently reported have been styled "Coccidioidal Granuloma." I may here mention in passing that Dr. Welch would never commit himself to the idea that these organisms were protozoa.

Other cases began to appear. Dr. D. W. Montgomery, of San Francisco, made cultures but found mycelia present in all his tubes. These he threw away, believing them contaminations. It remained for Dr. W. Ophüls to observe the mycelia growing out of the spherical organisms in the hanging drop, which observation put an end to the notion that these organisms were protozoa. Ophüls suggested the name "Oidiomycosis Coccidioides."

All of the cases have been fatal with one exception, which was cured by an early amputation. In our first case the disease lasted seven years before the patient died. It invaded both orbits, destroyed both eyes, both ears, and lips. It invaded the bones and the internal organs, particularly the lungs and testes, and the adrenals were as large as duck's eggs. The second case differed from the first in that the disease was much more virulent, the patient dying in two months. The organisms were also very different in that they were one-third larger and contained fewer though much larger spores. While the skin was the portal of entry in most cases, in a number it seemed that the lungs were primarily affected.

One important point of difference between coccidioidal granuloma and true blastomycosis is the fact that the former is not benefited by iodide of potassium. In our first case we were able to bring about healing of the cutaneous lesions by vigorous curetting and scrubbing of the surface with 1 to 500 bichloride of mercury.

With material from the first case we succeeded in inoculating a dog, producing a chronic sore from which we recovered the spherical organism at the end of six months.

Dr. Charles A. Powers, Denver (in closing):

My pathological friends gave me various names but until further proof it seems best to adhere to the original term blastomycosis. The one point which I would like to make, and which I would like to drive home, is this: that as in both of my fatal cases the condition began as a small skin nodule or a small abscess beneath the skin, it seems to me that our best hope of preventing dissemination and therefore of preventing the mortality which attends the systemic form, lies in the very early and very wide excision of these nodules.

THE VALUE OF GLUZINSKI'S TEST IN THE DIAGNOSIS OF GASTRIC ULCER

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PROFESSOR OF CLINICAL SURGERY AT THE UNIVERSITY OF CHRISTIANIA

THE chemical analysis of the stomach contents after test-meals is of relative value but not pathognomonic.[1] Many surgeons of large experience are even of the opinion that the chemical analysis takes only a very subsidiary place in the diagnosis of diseases of the stomach.

It therefore created considerable attention, when Kocher at the German Surgical Congress, 1912, recommended Gluzinski's reaction as a means of making the differential diagnosis between ulcer and cancer, thus bringing to the fore a half-forgotten method described for the first time some ten years ago.

Gluzinski[2] proceeds from the supposition, which is now going to be accepted as a fact, that a great number of cases of cancer of the stomach develop upon the basis of an ulcer.

His working hypothesis is as follows:

An *ulcer* situated in the pyloric portion being the cause of retention is, as a rule, accompanied by *hyperacidity* of the contents, while a *cancer* is attended by a mucous (or atrophic) catarrh which causes a *disappearance of the free hydrochloric acid*.

[1] W. J. Mayo, Operative Treatment of Cancer of the Stomach, Jour. Amer. Med. Assoc., Bd. lxi, No. 8.

[2] Gluzinski, Ein Beitrag zur Frühdiagnose des Magenkrebses, Mitt. aus. d. Grenzgeb. d. Med. u. Chir., 1902, Bd. x, p. 1.

During the transformation of an ulcer into a cancer there will yet be found free hydrochloric acid up to a certain stage of the disease. But during the progress of the mucous catarrh there will occur a *secretory insufficiency* which may be demonstrated by giving two test-meals, one meal following immediately upon the other.

Gluzinski examines the gastric contents (1) recovered from the fasting patient; (2) after administering a test breakfast consisting of the white of a boiled egg and 200 c. c. of water which is recovered after three-quarters of an hour; (3) after a test dinner consisting of a beefsteak and 250 c. c. of water which which is recovered after three and three-quarters hours.

The stomach is washed out before and after the first meal and the second meal is given immediately after the second washing.

In *ulcer* both the breakfast as well as the dinner give distinct reaction on free HCl.

In beginning cancer the *first meal* also will give distinct reaction of free HCl, while the *second one* will show only a slight trace, or free HCl will be altogether absent.

He diagnosed a beginning cancer in 3 cases, the diagnosis being verified at subsequent operation.

This method is being utilized by Kocher who has somewhat modified it and enlarged upon its applicability.

By determining the percentage of free HCl in the two meals he has found that the free acid is present in larger quantities after the second meal in *ulcer*, while in *cancer* this meal (the test dinner) shows the lowest percentage of hydrochloric acid.[1]

The preëminence of this method is that the diagnosis of ulcer or cancer is *not* based on the *absolute* value of free HCl in the gastric contents, but on the *increase* or *decrease* in the amount of free acid in the recovered meals.

But, moreover, he believes that the method may be used also in the *absence* of free hydrochloric acid, in which case the

[1] The cases tested in this way at the Clinic Berne are described by Fonio: Ueber die Resultate der Untersuchungsmethode nach Gluzinski u. c. w., Deutsche Zeitschr. f. Chir., Bd. cxvi.

total acidity shows the same proportions, always supposing that there is no lactic acid present.

In 30 cases of ulcer tested according to this modified *Gluzinski* method, the diagnosis was verified at operation in 27 cases, in 2 cases the result was uncertain and in 1 case there was found carcinomatous degeneration of an ulcer, although the test indicated the presence of a simple ulcer (Borghis or Pertit).

The results obtained by Kocher are to some extent being contested by Dr. Rusca,[1] Berne, while Kleinschmidt[2] and Hohlbaum,[3] both of Leipzig, speak very approvingly of the value of the test.

Before describing our own experiences I must state that both Gluzinski himself as well as Kocher and those who later have adopted the method most emphatically take reservations against the belief that they are accepting the results of this chemical reaction as decisive for the diagnosis. It is nothing but a symptom which is to be judged in conjunction with the other symptoms and with the history of the case.

As to *the theoretic foundation* for the method this seems to be pretty well laid.

My first assistant, Dr. Backer-Grondahl[4] has made some examinations upon an otherwise healthy person with a gastric fistula established because of a cicatricial stricture of the esophagus.

Grondahl administered Gluzinski's test-meals through the fistula and the results of his examinations are in accordance with those already known from the experiments of Pavlow upon animals and from the experiments by Hornberg upon the case of a patient with gastric fistula.

[1] Beiträg zur Magendiagnostic, etc., Correspondenz-Blatt f. Schweizer Aerzte, 1913, No. 46, p. 1498.

[2] Uberblick über das Magenmaterial der Leipziger chir., Universitat klinik.

[3] Ergebnisse der Salomonschen und der Gluzinskischen Probe, etc., Centralblatt f. Chir., 1913, No. 35.

[4] Forelobige resultäter med. Gluzinski's undersokelsesmethode, etc Nordisk Tidsskr. f. Terapi, xi, Aarg 11 H, 1913.

There occurs reflexly an increased production of gastric juice when the gastric mucous membrane receives an increased food irritation.

It has been shown that not only is the amount of gastric juice increased but also is the concentration of the hydrochloric acid greater as the irritation increases.

At the surgical clinic of Christiania University we have employed the Gluzinski method since October, 1912, in the examination of 86 cases, to wit: 25 cases of gastric ulcer, 9 cases of duodenal ulcer, 21 cases of cancer of the stomach, 15 cases of gastro-enteroptosis, 11 cases of chronic appendicitis and 5 cases of gall-stones.

The diagnosis is in all of the cases controlled by operation, some of the ptosis cases only by röntgenography.

Of our *cancer* cases two only had free hydrochloric acid and in both the test agreed with the results as obtained by Gluzinski, to wit: a *decreasing* amount of free hydrochloric acid in the test dinner (Fig. 1).

In those cases of cancer of the stomach where free hydrochloric acid was absent we have found *no regular decrease of the total acidity;* we are so far unable to support the statement made by Fonio, that the method may be used in such cases.

In fact, the total acidity was *increasing* in the second test-meal in about 50 per cent. of the cases.

During our further examinations we soon arrived at the conclusion, however, that the percentage of free HCl may *decrease* in the second meal *also in diseased conditions of the gastro-intestinal canal other than cancer of the stomach.*

We found the free hydrochloric acid values to be diminishing in the test dinner in cases of *gastro-enteroptosis.*

But not in all of them—the phenomenon was not dependent upon the anatomical position of the gastro-intestinal canal in itself—we found it in cases where chronic obstruction appeared simultaneously with gastro-enteroptosis (Fig. 2). Cases of gastro-enteroptosis without obstruction are shown on Fig. 3.

In the first of those cases we made resection of the pylorus

FIG. 1

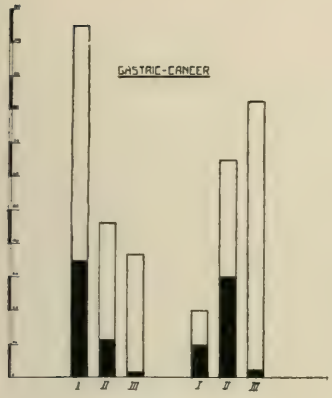

FIG. 2

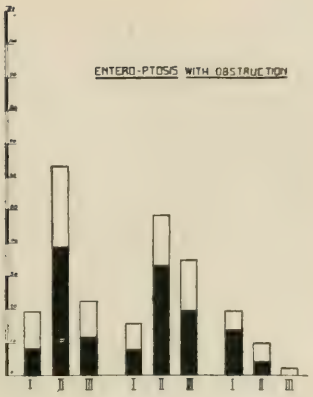

FIG. 3

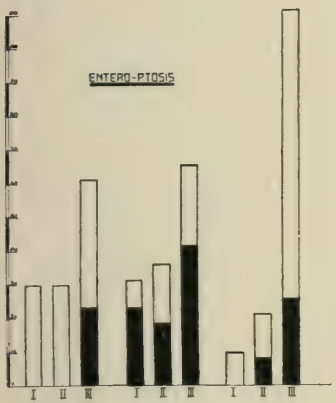

FIG. 4

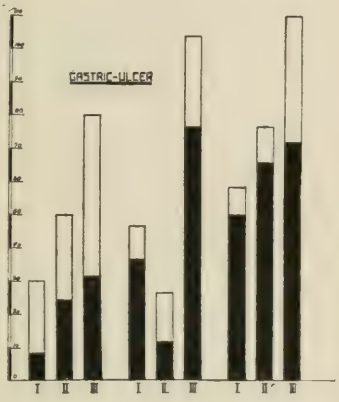

FIG. 5

Diagrams of acid-values in the gastric contents. I, recovered from the fasting patient; II, recovered after the test breakfast; III, recovered after the test dinner. Black, free hydrochloric acid; white, total acidity.

because we imagined that we felt a hard little notch in the wall of the stomach. But microscopical examination of the resected piece did not show any traces of cancerous degeneration.

Gluzinski's test is a test of function, which demonstrates the failing ability of the mucous membrane to secrete hydrochloric acid.

But this failing ability may be found also in other conditions than those prevailing during the development of cancer. Further experience will show which are those conditions.

It only confirms the statement made by Dr. W. J. Mayo that the "early diagnosis of cancer does not depend on any sign or symptom due to the cancer itself."

By examining 25 cases of *gastric ulcer* we found that all of them but one[1] reacted in the manner described by Gluzinski and Kocher as being characteristic of ulcers of the stomach, to wit: with a decided increase in the percentage of the hydrochloric acid and of the total acidity.

After ingestion of the beefsteak rather high values of hydrochloric acid are obtained, and this is possibly most pronounced in those cases in which the dyspeptic symptoms are most severe (see Fig. 4).

So strongly pronounced and so apparent has this phenomenon been in our cases that it possibly may be used as a differential symptom in the diagnosis between ulcer and other diseased conditions of the gastro-intestinal tract attended by dyspepsia.

Thus in two cases referred to us from the medical ward with the diagnosis of callous ulcer—in one of them this was even the Röntgen diagnosis—we found hypoacidity with very little increase after the test dinner.

In none of them was ulcer found at the operation. A few adhesions between the duodenum and the gall-bladder were

[1] Male, aged forty-four years. The hydrochloric acid percentage after the beef-meal decreased a little, while the total acidity increased. The difference was, however, slight, and at the operation it could not be decided whether a cancer positively was developing or not, as the stomach was imbedded in a mass of firm perigastric adhesions.

separated and both patients have later informed us that they have got rid of their previous very severe symptoms after the operation.

On Fig. 5 I have given a graphic diagram of the acid values found in some cases of gall-stones examined according to Gluzinski's test.

By comparing the columns with those belonging to ulcer cases (Fig. 4) the difference will seem striking.

In our 9 examined cases of duodenal ulcer the hydrochloric acid values were not as high as in gastric ulcer and the increase in the percentage of free acid in the second meal was moderate in 7 cases, while it was relatively great in two cases.

But the difference in this respect between gastric and duodenal ulcer is not great enough to be made use of as a means of differential diagnosis.

We have tried to differentiate between various forms of appendicular dyspepsia, but have as yet obtained no definite results.

In our opinion Gluzinski's method is better than any other for testing the secretorial function of the stomach.

Thus, in cases where free hydrochloric acid apparently is absent and not to be found after an Ewald's test breakfast, the second meal in some cases will produce a gastric juice containing hydrochloric acid.

As a whole, we have found Gluzinski's test reliable. It ought to be used as a help to make the differential diagnosis in doubtful cases of gastric ulcer.

THE RÖNTGENOLOGIC DIAGNOSIS OF SURGICAL LESIONS OF THE STOMACH AND DUODENUM

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AND
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NEW YORK CITY

THE object of this communication is to report a series of cases furnishing data which may help to solve two important questions:

First, is there reason to believe from our present experience that the Röntgen ray will eventually prove as valuable for the diagnosis of surgical lesions of the stomach and duodenum as for the diagnosis of fractures and urinary calculi?

Second, what method of Röntgen examination gives the most accurate results? In the first question it will be noted that we have used for comparison only the diagnosis of fractures and urinary calculi. While röntgenology has proved of great assistance in the solution of many diagnostic problems, such as joint and bone diseases, pulmonary tuberculosis, aneurisms, sinus infections, etc., the surgeon accepts the röntgenographic evidence of fractures and renal and ureteral calculi as final, and of greater value than the clinical history or the results of a most painstaking physical examination, or both methods combined. As a result of the accuracy with which these lesions are recognized by skilled röntgenologists, few if any experienced surgeons of the present day will accept the responsibility of treating a complicated fracture or of advising surgical intervention in a case of urinary calculi without the aid of a röntgenologic examination, if it is possible or practical to obtain one.

What then is the present status of röntgenology in surgical lesions of the stomach and duodenum? A brief review of the history and development of gastro-intestinal röntgenology may help to answer this question.

The first report on röntgenographic examination of the human stomach was published by Hemmeter in 1896.[1] Early röntgenograms of the stomach were blurred and unsatisfactory, because long exposures were required. The fluoroscopic screen was therefore the more successful method until instantaneous röntgenograms were made possible by the advent of the intensifying screen. Not long afterward, Kaestle, Rieder, and Rosenthal[2] reported their bioröntgenographic observation of the gastric motor phenomena; but subsequent publications fail to show that they have taken advantage of this valuable method for practical diagnosis. Inspired by their work, we started by making 12 röntgenograms in rapid succession. This number has been gradually increased until now we always make 40 and usually 50 or 60 röntgenograms in several series, with the patient in various postures, and at intervals of two hours, until the stomach is empty, a method to which the name serial röntgenography has been applied. These röntgenograms are studied individually and collectively and superimposed upon each other for comparison, or reproduced cinematographically.

Recently we have perfected a true röntgenocinematographic machine capable of making 50 röntgenograms of a single cycle, or 200 röntgenograms of the progression of an individual peristaltic contraction from the fundus to the pylorus in a 4-cycle type of stomach. The information gained by such an examination or by serial röntgenography includes:

Size, position, and shape or type of the stomach.

Activity of the peristalsis, and width of the peristaltic contractions.

[1] Photography of the Human Stomach by the Roentgen Method. Boston Med. and Surg. Jour., June 18, 1896, p. 609.

[2] The Bioröntgenography of the Internal Organs. Arch. of the Roent. Ray, June, 1910, p. 3.

Character of the systole and diastole.

Depth of the rugæ and the direction in which they run.

Degree of dilatation, and the motor phenomena of the descending and horizontal duodenum.

Pyloric sphincter, whether clear-cut and well defined on both surfaces and $\frac{3}{16}$ inch wide, or irregular in contour and wider than normal.

Cap (pilleus ventriculi), whether symmetrical, corresponding in size and contour with the pars pylorica, or invisible, deformed, or spasmodically contracted.

The first inch and a half of the gut, beyond the pyloric sphincter, viz., the cap (pilleus ventriculi), is stomach and not duodenum, considered embryologically, histologically, physiologically, anatomically, and surgically. The cap is the most important portion of the whole gastric tract, and its röntgenologic appearance is of inestimable value in the diagnosis of lesions in the right hypochondrium.

The diagnosis of extensive gastric lesions is based on permanent filling defects in the walls of the stomach or cap, whereas the diagnosis of early lesions, particularly of small, indurated ulcers and adhesions, is based on the interruption of peristaltic contractions as they progress pylorusward. The wealth of detail obtained when the bismuth is suspended in buttermilk enables one to differentiate many of the non-malignant lesions from indurated gastric ulcer or carcinoma. Theoretically the method of interpreting röntgenographic findings is much the same as that employed by the pathologist in making a diagnosis from a pathologic specimen. All of the evidence assembled is utilized in making deductions, no single phenomenon being accepted as conclusive proof of a condition.

The interpretation of the röntgenograms and the diagnosis of the 27 consecutive cases described in this communication are the result of a study of about 20,000 röntgenograms of 700 cases. The 27 cases reported herein include all cases examined röntgenographically by Dr. Cole and subsequently operated upon by Dr. Brewer. Each case was referred to Dr. Cole with the simple

statement that an organic lesion of the stomach or duodenum was suspected; no history or data obtained by physical examination or gastric analysis being furnished. As a result of the röntgenographic examination, a typewritten report was returned, giving the exact findings and an opinion regarding the presence or absence of a gastric or duodenal lesion, its location, extent, and probable cause. In several cases a lesion of some other portion of the gastro-intestinal tract was diagnosticated. Later each case was explored, and the findings at operation were recorded.

The röntgenologic report on the first three cases will be given in full to indicate the method employed and the reasons for the final diagnosis. In the other cases only the final conclusions will be quoted. The full reports are on file in Dr. Cole's library and in the hospital records.

Case I.—*Clinical History.* C. H. P.; man; chronic dyspepsia for ten years. Began with pain after meals, belching of gas, and occasional sour eructations. Always worse after severe nervous strain. Some relief from medical treatment. Present condition: well nourished, active man. Complains of pain of a heavy, burning character one to three hours after meals. Often relieved by food or vomiting. History of occasional attacks of pain in right iliac fossa. Gastric analysis showed marked hyperacidity.

Röntgenographic Findings. Three röntgenograms of the gall-bladder region show the ribs, spine, transverse processes, and kidney distinctly. There is no evidence of any shadow which could possibly be interpreted as a gall-stone, but one is not justified in making a negative diagnosis of this condition solely from the röntgenographic findings.

A series of röntgenograms of the stomach, made with the patient in both the prone and erect postures, and in the anterior and posterior directions, shows its size, shape, and position distinctly.

Type: Text-book.

Size: Dilated.

Position: Slightly prolapsed.

Peristalsis: 3-cycle type, equal on the greater and lesser curvatures, and unobstructed, except possibly at the extreme pyloric end of the stomach.

Systole and diastole: Shown distinctly.

Jejunum: Shown distinctly.

Duodenum (descending and horizontal portions): Shown distinctly.

Cap (first portion of the duodenum): Contracted in all the röntgenograms, and fails to have the clear-cut, well-defined edges of a normal cap.

Pyloric sphincter: Distorted by the contraction of the cap, especially on its duodenal surface.

The extreme pyloric end of the stomach on the lesser curvature presents a cup-shaped depression, which may be due either to a slight involvement by adhesions, or to a pressure from without.

A plate made six hours after the ingestion of bismuth, and after the patient had eaten a chop, baked potato, and some bread, shows a considerable retention of food in the stomach. The outer side of the cap shows more distinctly than the inner, indicating that the lesion is on the left side of the cap.

Röntgenologic Diagnosis. From a study of these plates, I believe we are justified in making a negative diagnosis of new growth of the stomach. There is, however, a definite lesion involving the cap. This does not have any of the röntgenographic evidence of malignancy, and I believe that it is due to a cicatricial contraction either from a duodenal ulcer or from gall-bladder infection. The weight of the evidence is strongly in favor of a duodenal ulcer on the lesser curvature side of the cap. Considering the definite lesion of the cap, and the moderate dilatation of the stomach and the retention of food after six hours, I believe that surgical procedure is indicated regardless of the symptoms.

Surgical Findings. The stomach was normal. In the duodenal wall, one-half inch from the pylorus, was an oval indurated nodule, about 2 cm. in diameter.

A posterior gastro-enterostomy was performed.

A chronically thickened appendix was also removed through a second incision.

CASE II.—*Clinical History.* O. H.; man; thirty-two years of age. Chronic indigestion for seven years. Pain, sense of weight, nausea, and sour eructations after meals, often relieved by vomiting. Would often induce vomiting to relieve pain. Has lost flesh and strength through lack of food. No relief from eating. In hospital complained of severe pain after solid food. Gastric analysis showed hyperacidity. Wassermann test: 4 plus.

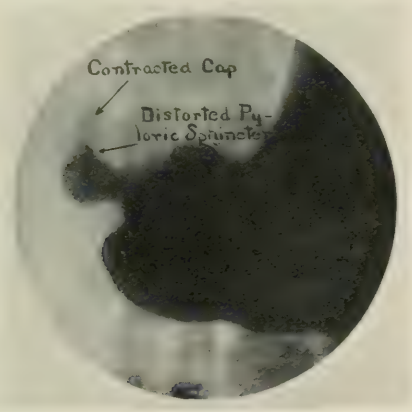

FIG. 1.—Clinical diagnosis: ulcer of the cap. Röntgenologic diagnosis: ulcer of the cap. Surgical findings: ulcer of the cap. Case I.

Röntgenographic Findings. Röntgenograms focussed over the gall-bladder region show no evidence of any shadow which could possibly be interpreted as a gall-stone, but one is not justified in making a negative diagnosis of such a condition solely from the röntgenographic findings.

A series of röntgenograms of the stomach, made immediately after, and two, seven and one-half, and twenty-three hours after the ingestion of bismuth, shows the size, shape, and position of the stomach, and the progress of the food through the tract.

Type of stomach: Deformed.

Size: Normal.

Position: Normal.

Peristalsis: 3-cycle type, obstructed on both greater and lesser curvatures in region of pars pylorica.

Systole and diastole: Shown distinctly.

Jejunum: Shown distinctly.

Duodenum (descending and horizontal): Shown distinctly.

Cap (first portion of duodenum): Contracted on left side.

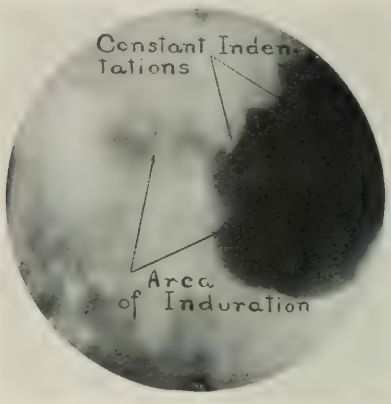

FIG. 2.—Clinical diagnosis: gastric ulcer. Röntgenologic diagnosis: gastric ulcer, with extensive induration, extending along greater and lesser curvatures of entire pars pylorica. Surgical findings: massive, gummatous induration, occupying pyloric extremity of stomach and extending from greater to lesser curvature. Chronic ulcer. Case II.

The entire pars pylorica, and part of the pars media fail to expand and contract in a normal manner. Although the food begins to pass out of the stomach at an early stage after ingestion, there is considerable gastric retention seven and one-half hours later. In these röntgenograms the head of the bismuth column is at the hepatic flexure. The terminal portion of the ileum is considerably dilated.

Röntgenologic Diagnosis. The findings indicate the presence of a primary gastric ulcer, the crater of which lies about three inches from the pyloric sphincter. Extensive induration surrounds the ulcer and extends along the greater and lesser curvatures of the pars pylorica, which shows annular constriction.

Two torsive folds extend up along the gastric wall. The cap also is involved in adhesions. Whether or not any of the induration surrounding the ulcer has begun to undergo carcinomatous changes as yet, can be determined only by microscopic examination after its removal.

Surgical Findings. A massive induration occupied the pyloric extremity of the stomach and extended from the lesser to the greater curvature, chiefly on the posterior surface. This was adherent to the transverse mesocolon, which was so infiltrated as to preclude the possibility of a posterior gastro-enterostomy. A number of enlarged lymph nodes were present along the greater curvature, two of which were removed for microscopic examination.

An anterior gastro-enterostomy was done by the suture method.

The enlarged lymph nodes showed no malignancy, only inflammatory hyperplasia.

Pathologist's Report. Diagnosis: Chronic ulcer of the stomach with extensive gummatous infiltration.

CASE III.—*Clinical History.* W. H.; man; aged thirty-nine years. Three months before admission began to have food distress with sharp pain radiating to left side of chest, sour eructations, and constant hunger. Food often relieves the pain. There is no loss of weight or strength. Physical examination revealed movable tumor in epigastrium.

Gastric analysis: No free HCl or lactic acid. Trace of blood. Hemoglobin, 59 per cent.

Röntgenographic Findings. A series of röntgenograms of the stomach, made immediately and three hours after the ingestion of bismuth shows the size, shape, and position of the stomach distinctly.

Type: Deformed.

Size: Normal.

Position: Normal.

Peristalsis: 2 cycle type. Obscured along the entire lesser curvature.

Jejunum: Shown distinctly.

Duodenum (second and third portions): Shown distinctly, is symmetrical, corresponding in contour with the pyloric end of the stomach; separated from the pars pylorica by a space of about one-eighth inch, indicating the pyloric sphincter, both surfaces of which are clear-cut, and the lumen of which is centrally located.

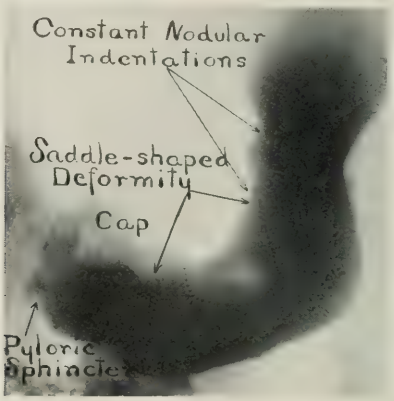

FIG. 3.—Clinical diagnosis: gastric cancer. Röntgenologic diagnosis: extensive carcinoma, involving entire lesser curvature. Surgical findings: extensive carcinoma, involving most of lesser curvature. Case III.

There is no evidence of peristalsis on the lesser curvature, and its contour from the cardia to within one and one-half inches of the pylorus is absolutely constant in all the röntgenograms. The involvement extends down along both the anterior and posterior walls of the stomach.

Röntgenologic Diagnosis. The röntgenologic evidence in this case indicates an extensive new growth involving the entire lesser curvature in much the same manner as a saddle-shaped ulcer. Considering its great extent, and the constant nodular indentations, presenting the finger-print appearance, I believe we are justified in making a diagnosis of carcinoma too extensive for reasonable hope of removal.

Surgical Findings. An extensive saddle-shaped carcinoma involved most of the lesser curvature, and extended downward

on both anterior and posterior surfaces. There was no definite induration at the pyloric ring.

A partial gastrectomy was performed.

CASE IV.—*Clinical History.* O. V.; woman; aged thirty-three years. Early history of appendix infection followed by appendectomy seven years ago. Complains of epigastric pain, coming on four hours after meals. Sour eructations and frequent vomiting of sour material with relief of pain. Has lost weight and strength. No jaundice. Physical examination negative except for epigastric tenderness.

FIG. 4.—Clinical diagnosis: ulcer of the cap. Röntgenologic diagnosis: normal stomach and cap. Surgical findings: normal stomach and cap. Case IV.

Gastric analysis: Free HCl. 30. Total. 60. Blood present in small amount.

Röntgenographic Diagnosis. There is no evidence of new growth, indurated ulcer or adhesions involving the stomach or cap, and therefore no röntgenologic indication for surgical procedure on the stomach or duodenum.

Surgical Findings. The stomach and duodenum were normal.

A chronically thickened and adherent gall-bladder was found containing two large stones.

A cholecystectomy was performed.

Case V.—*Clinical History.* Mrs. H., aged forty years. Patient has a history of having had several acute attacks of abdominal pain and fever, followed by soreness in the lower abdomen. One of these attacks had been diagnosticated as acute appendicitis by a competent physician, who advised operation in the interval. Subsequently she had suffered from digestive distress with more or less epigastric pain, gas, and sour eructations after meals. These symptoms would occur at variable intervals, last two or three weeks, and then disappear.

Fig. 5.—Clinical diagnosis: ulcer of the cap. Röntgenologic diagnosis: normal stomach and cap. Surgical findings: normal stomach and cap; diseased appendix. Case V.

On examination there was tenderness over the right hypochondriac and epigastric regions. Also tenderness at McBurney's point.

Röntgenologic Diagnosis. There is no evidence of adhesions or new growth involving the stomach or cap. The first bismuth which passed out of the stomach proceeded rapidly through the jejunum and upper part of the ileum into the ascending and transverse colon. The food then ceased to pass through the second and third portions of the duodenum, although a large amount of bismuth still remained in the stomach and cap. The

fact that the pylorus was open indicates that there was no obstruction to account for this retention at the pyloric sphincter.

Surgical Findings. The stomach, duodenum, and gall-bladder were normal. A chronically diseased appendix was removed through a second incision.

CASE VI.—*Clinical History.* Mrs. B., aged forty-four years. Appendix removed several years ago. For past two years patient has complained of more or less constant epigastric distress after meals, with occasional vomiting of sour material. At

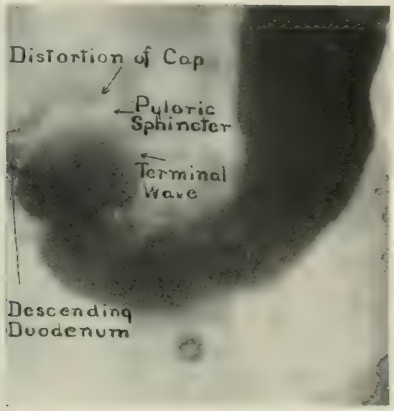

FIG. 6.—Clinical diagnosis: gall-bladder infection. Röntgenologic diagnosis: gall-bladder adhesions, involving the cap. Surgical findings: gall-bladder adhesions involving the cap. Case VI.

frequent intervals this distress would become accentuated, and associated with severe pain over the region of the gall-bladder. While the symptoms were rather indefinite, the patient had lost much weight and strength and found it difficult or impossible to attend to her household duties. Physical examination revealed a generalized tenderness over the entire epigastric region, and well-marked Murphy's sign.

Röntgenologic Diagnosis. The röntgenographic examination revealed only a slight distortion of the cap, probably due to an adhesion of the gall-bladder.

Surgical Findings. There was a small band of inflammatory adhesion at the summit of the gall-bladder and adjacent liver border, extending to the junction of the first and second portions of the duodenum. This was divided.

CASE VII.—*Clinical History.* E. S., woman. For the past seven months this patient had suffered from a progressively increasing epigastric distress after eating, belching of gas, and of late, frequent vomiting. Record of physical examination, gastric analysis, and blood-test have been lost.

FIG. 7.—Clinical diagnosis; gastric carcinoma. Röntgenologic diagnosis: carcinoma, involving pars pylorica, more extensive on the lesser curvature. Surgical findings: carcinomatous induration involving the pylorus and extending along the lesser curvature. Case VII.

Röntgenologic Diagnosis. The extreme pyloric end of the stomach is constricted by an annular growth, more extensive on the lesser curvature than on the greater, and more extensive anteriorly than posteriorly. The weight of the evidence is in favor of the growth being malignant. Immediate surgical procedure is indicated.

Surgical Finding. A fairly extensive carcinomatous induration was found, involving the pylorus and extending along the lesser curvature half-way to the esophageal junction.

A partial gastrectomy was performed.

Case VIII.—*Clinical History.* N. H.; man. Seven years ago began to experience pain after eating, located in epigastrium, often relieved by food. Symptoms would occur in periods varying from four to six weeks at a time, followed by more or less complete relief for a longer or shorter period. Ever since onset of symptoms has had more or less dyspepsia with acid eructations. Occasional attacks of pain and discomfort over appendicular region without reference to the taking of food. At present, pain more pronounced three or four hours after mid-day meal.

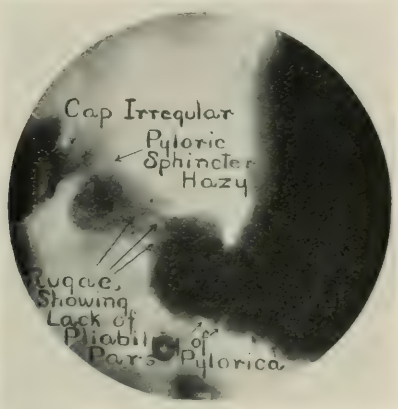

Fig. 8.—Clinical diagnosis: ulcer of the cap. Röntgenologic diagnosis: lack of normal expansion and contraction of gastric walls, due to some functional disturbance. Case VIII.

Röntgenologic Diagnosis. There is no evidence of new growth or indurated gastric ulcer. The irregular shape of the cap, the hazy edges of the sphincter, the lack of normal expansion and contraction of the pyloric end of the stomach, together with the appearance of the peristaltic contractions and the abnormal rugæ in this region, indicate that there is some lesion involving this portion of the stomach, probably adhesions, either from gall-bladder infection or from an ulcer. No evidence of an indurated gastric ulcer can be detected, but the constant indentation in the left side of the cap may be a duodenal ulcer. The fact that the food passed readily out of the stomach during the

early stage of digestion indicates that there is no pyloric obstruction. The stasis of food in the stomach six hours after its ingestion, however, would indicate that there was an obstruction; but this stasis is probably due to some functional disturbance of the stomach or duodenum, rather than to an organic obstruction of the pylorus.

Excerpt from Dr. Cole's letter to Dr. Brewer: "This case of Mr. H. is typical of a group of about 20 cases, which show evidence of a definite lesion involving the pyloric end of the stomach and the cap. I have never felt that I could advocate surgical procedure in any such instances, although I am exceedingly anxious to know what pathologic condition causes these röntgenographic findings."

Surgical Findings. The stomach and duodenum were normal. No evidence of cholelithiasis or inflammation of the gall-bladder could be found. The appendix was removed. It was thickened, presented an obliterating stricture in its distal third, and was distended at the tip.

Case IX.—*Clinical History.* L. R.; woman. Patient was first seen by the writer during an attack of incomplete intestinal obstruction. Prior to the occurrence of these symptoms, she had suffered from dyspeptic symptoms for a number of years, associated with occasional attacks of severe epigastric pain. Shortly before the symptoms of obstruction appeared, two series of röntgenograms of the stomach and duodenum were made.

Röntgenologic Diagnosis. The shadow in the gall-bladder region is a little too high for the normal position of the gall-bladder, but it certainly has the appearance of a rather large gall-stone. The absence of the duodenum, the contracted cap, the irregular and worm-eaten appearance of the pylorus, and the absence of the pyloric sphincter indicate a lesion in this region which calls for surgical procedure. This lesion is probably adhesions from gall-bladder infection with a calculus, but considering the irregular worm-eaten appearance of the pyloric end of the stomach, the possibility of carcinomatous degeneration cannot be eliminated.

Surgical Findings. The upper part of the jejunum was distended. On following the distended bowel downward for about one meter, a hard oval mass was found, almost completely filling the lumen. Below this mass the bowel was collapsed. On opening the bowel, the obstruction mass was found to be an enormous oval gall-stone, measuring 3 cm. in its long diameter, and 2 cm. in its short diameter. The presence in the upper jejunum of a gall-stone of this size could be explained only by its sloughing through the walls of the gall-bladder and duodenum, creating the lesion described in the röntgenologic report.

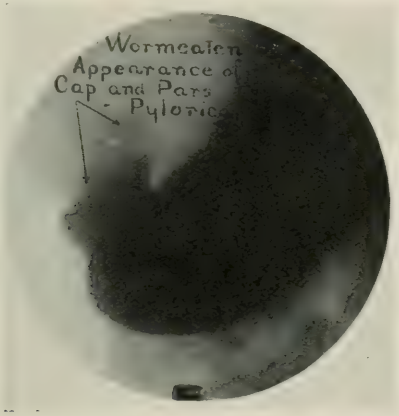

FIG. 9.—Clinical diagnosis: intestinal obstruction. Röntgenologic diagnosis: gall-bladder infection with a calculus, causing adhesions involving pars pylorica. Surgical findings: gall-stone obstructing upper part of jejunum, cholecystitis. Case IX.

CASE X.—*Clinical History.* F. C.; woman. Entered the hospital for attacks of epigastric pain and sour vomiting. Appendix removed eighteen months before admission. Since that operation has complained constantly of irritable stomach, irregular pains in epigastric, inguinal, and umbilical regions, prostration, weakness, loss of flesh, and vomiting. Gastric analysis: Free HCl, 26; total acidity, 50; no lactic acid or blood.

The clinical picture was not characteristic of any definite

lesion, but as the patient was practically bedridden, and constantly losing flesh, an exploratory operation was advised.

Röntgenologic Diagnosis. There is no röntgenologic evidence of gastric carcinoma or indurated ulcer. The incomplete filling of the cap in the majority of the plates would make one extremely suspicious of a duodenal ulcer, but as a practically normal cap presents in one or two of the röntgenograms, its constriction in the majority of the plates must be due to a spasmodic contraction, probably associated with a pylorospasm. There is a slight possibility that this pylorospasm is caused by a small duodenal

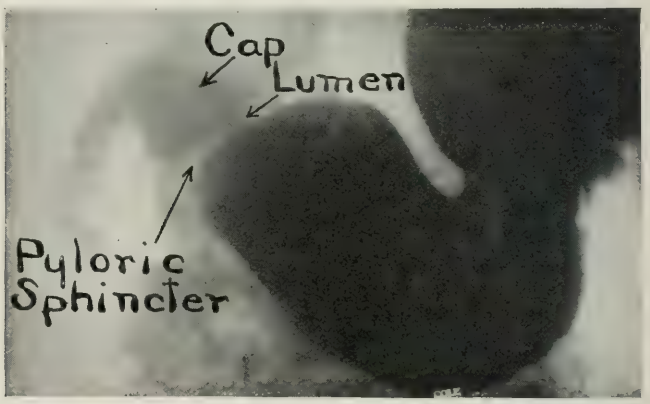

FIG. 10.—Clinical diagnosis: ulcer of the cap. Röntgenologic diagnosis: spasm of cap and pars pylorica. No organic lesion of stomach or cap. Surgical findings: normal stomach and duodenum. Case X

ulcer on the lesser curvature of the cap, but there is not sufficient evidence to justify one in coming to such a conclusion.

Surgical Findings. The stomach and duodenum, as well as the gall-bladder, pancreas, and colon were normal.

CASE XI.—*Clinical History.* J. McG.; man. Three years ago began to have epigastric pain after meals, generally relieved by food and occasionally by belching. Freedom from symptoms for periods of variable duration. Occasionally attacks of sudden weakness with marked pallor. Did not notice color of stools. All symptoms relieved when on a purely milk diet, but

would return on resuming solid food. Gastric analysis: Free HCl, 80; total, 105; no lactic acid or blood.

Röntgenologic Diagnosis. Röntgenograms of the stomach show no evidence of new growth or indurated ulcer. The absence of the cap justifies a suspicion of some lesion involving this portion of the duodenum, possibly a duodenal ulcer. But the fact that the chyme passes rapidly out of the stomach into the second and third portions of the duodenum, jejunum, and even down into the ileum, indicates that there is little or no obstruction to the evacuation from the stomach of fluid contents.

FIG. 11.—Clinical diagnosis: ulcer of the cap. Röntgenologic diagnosis: ulcer of cap. Surgical findings: ulcer of the cap. Case XI.

Unfortunately four- and six-hour plates, to determine how completely the stomach emptied itself, were not made.

Surgical Findings. The stomach was somewhat dilated. A moderate-sized induration was found in the first part of the duodenum, one-half inch from the pylorus. The peritoneal surface of the duodenum was puckered and scarred over the surface of the induration. A posterior gastro-enterostomy was performed.

CASE XII.—*Clinical History.* T. M.; man. Suffered for two years from pain, two or three hours after meals, relieved by

vomiting or taking more food. Often induces vomiting to relieve pain. Of late he had copious vomiting, once every three or four days. No blood in vomitus. Stools often black in color. Loss of forty pounds in weight. Gastric analysis: Free HCl, 40; total, 60; no lactic acid or blood.

Röntgenologic Diagnosis. There is an obstruction of the cap, causing an immense dilatation of the stomach. This is caused by an ulcer on the anterior surface of the cap. Surrounding adhesions involve the pyloric sphincter, and possibly also extend onto the stomach.

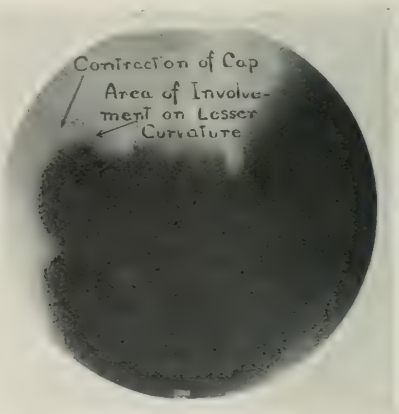

FIG. 12.—Clinical diagnosis: ulcer of the cap. Röntgenologic diagnosis: ulcer of the cap, with adhesions involving the pyloric sphincter and lesser curvature of par pylorica. Surgical findings: ulcer of the cap with dense induration extending for a short distance along lesser curvature of stomach. Case XII.

Surgical Findings. There was a dense indurated area in the first part of the duodenum, extending for a short distance along the lesser curvature.

A gastro-enterostomy was performed.

CASE XIII.—*Clinical History.* P. O'B.; man. For five years patient has suffered from a gnawing pain in the epigastrium, coming on two or three hours after eating, and continuing until relieved by the next meal. There are frequent eructations

of gas during period of pain, and occasionally a small amount of sour irritating fluid rises in the throat. Stools often black in color. Has vomited only twice. No blood seen in vomitus. Has not lost weight or strength.

Röntgenologic Diagnosis. A definite lesion involves the extreme pyloric end of the lesser curvature of the stomach, causing an anterior retraction of the cap. This corresponds with an ulcer of the cap, but the röntgenographic findings indicate that most of the induration involves the stomach, rather than the

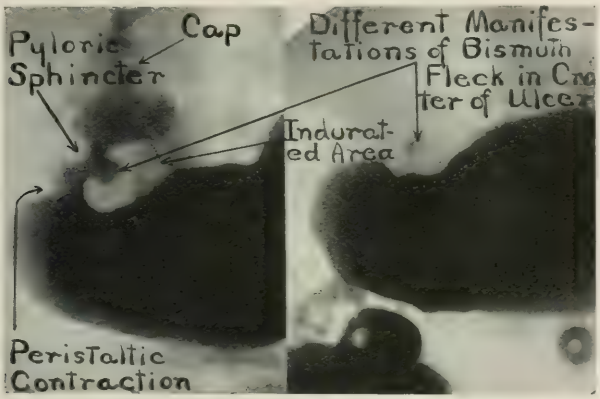

FIG. 13.—Clinical diagnosis: gastric or duodenal ulcer. Röntgenologic diagnosis: ulcer of the gastric side of the pyloric sphincter, most of the induration involving the stomach on the lesser curvature, although the cap also is encroached upon. Surgical findings: induration of the cap near the pylorus, with slight thickening along lesser curvature of stomach for three-fourths of an inch. Case XIII.

cap, although the lesion may have started in the postpyloric surface of the sphincter. There is no evidence of obstruction. The bismuth-filled crater and the everted edges of the ulcer viewed in profile are classical. Whether or not there are any carcinomatous changes at the base of this ulcer, can be determined only by a microscopic examination.

Surgical Findings. A duodenal induration was found near the pylorus, with slight thickening along the lesser curvature for a distance of three-quarters of an inch.

A gastro-enterostomy was performed.

Case XIV.—*Clinical History.* Since first child was born, 22 months ago, patient has suffered almost constantly with dull epigastric pain, which has no relation to eating. Pain radiates over whole abdomen, but is marked in upper right quadrant, and frequently passes through to back and up to shoulder. Causes vomiting when severe. Vomitus bitter, with dark red streaks like blood on two or three occasions. Bowels constipated. Stools very dry. No urinary symptoms. Has never been jaundiced. Has lost about 40 pounds in three years.

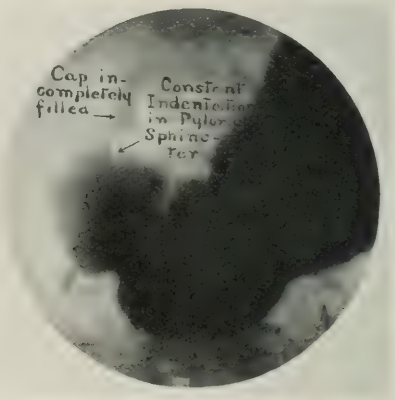

Fig. 14.—Clinical diagnosis: ulcer of the cap. Röntgenologic diagnosis: no evidence of gastric or duodenal lesion. Surgical findings: normal stomach and cap. Case XIV.

Röntgenologic Diagnosis. The röntgenographic findings justify a negative diagnosis of new growth of the stomach, except possibly at a minute area near the pylorus. The incomplete filling of the cap, the abnormal pyloric sphincter, and the constant indentation on the lesser curvature of the extreme pyloric end of the stomach, are the most important röntgenographic findings, and indicate some lesion at this point. Considering the incompleteness of the examination, one is not justified in stating with certainty whether there is an ulcer of the cap or adhesions from some other cause.

Surgical Findings. The stomach, duodenum, and gall-bladder were normal. A chronic appendix was removed.

CASE XV.—*Clinical History.* J. A.; man. About six months ago developed dull, "grinding" pain in epigastrium about one hour after meals, lasting from ten to twenty minutes; never very severe. Does not radiate up or down, is relieved by medication, belching, or taking food, and has never caused vomiting. Symptoms disappear on rigid dieting, but return when regular diet is resumed. Stools not tarry in color. Bowels regular. No urinary disturbance.

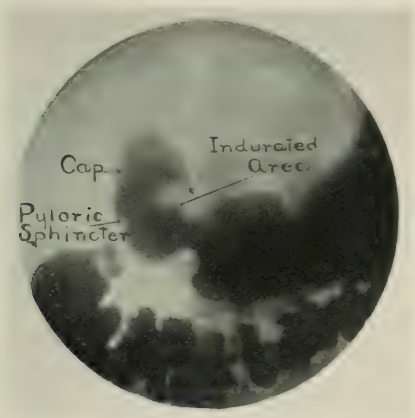

FIG. 15.—Clinical diagnosis: ulcer of cap or stomach. Röntgenologic diagnosis: minute ulcer, with induration involving cap, pyloric sphincter and lesser curvature of pars pylorica. Surgical findings: small, shot-like induration on duodenal side of pylorus. Case XV

Röntgenologic Diagnosis. The röntgenographic findings present no evidence of gastric carcinoma. The increased width of the pyloric sphincter on the lesser curvature side of the lumen, and the irregularity of the extreme pyloric end of the stomach and the left side of the cap, indicate that there is a minute lesion involving the cap, sphincter, and the extreme pyloric end of the stomach. The entire involvement, including induration and adhesions, is less than half an inch in diameter, and causes absolutely no interference with the evacuation of the stomach.

In fact, it probably acts as an irritant, causing the stomach to evacuate itself with more than normal rapidity. This is by far the smallest lesion that I have been able to recognize by this method of examination. It corresponds with Codman's pathologic description of a healed ulcer, or my own conception of an extremely early ulcer.

Surgical Findings. A small, shot-like induration was discovered on the duodenal side of the pylorus. The stomach was normal.

A gastro-enterostomy was performed.

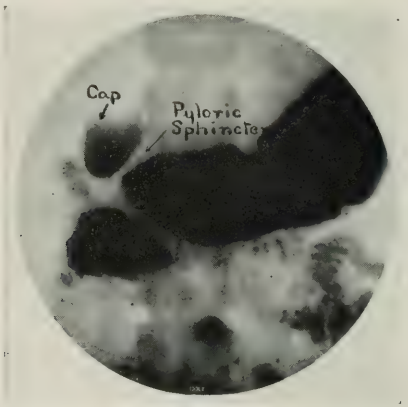

FIG. 16 —Clinical diagnosis: definite ulcer of the cap. Röntgenologic diagnosis: normal stomach and cap. Surgical findings: normal stomach and cap. Case XVI.

CASE XVI.—*Clinical History.* R. R.; woman. For the past six months, patient has suffered from abdominal pain, chiefly located in right iliac fossa, aggravated by taking solid food. Pain increases about half an hour after meals. Some nausea. No vomiting. Is much troubled by belching of gas and sour eructations. Has lost 20 pounds.

Gastric analysis: Free HCl, 29; total, 51; no lactic acid or blood.

Röntgenologic Diagnosis. The röntgenographic findings justify a negative diagnosis of new growth or indurated ulcer of

the stomach or cap. The localized collection of bismuth in a coil of the intestine, in the position of the third portion of the duodenum, is a very constant finding in all the röntgenograms. This is probably due to a kink at this point with partial obstruction, but it is difficult to conceive of such a kink in this region. There is no röntgenographic indication for surgical procedure upon the stomach or cap, but if the symptoms correspond with the localized accumulation of bismuth above described, the plates could then be used as strong corroborative evidence for operative procedure.

Surgical Findings. No lesion of the stomach, duodenum or gall-bladder was found. The upper portion of the jejunum was examined and found to be normal. A chronically diseased appendix was removed.

CASE XVII.—*Clinical History.* S. S.; man. Three years ago patient began to notice epigastric pain coming on directly after meals, lasting one to two hours, disappearing spontaneously, leaving him free until the next meal. Induced vomiting at times to relieve pain when very severe. Much troubled by belching and sour eructations during period of pain. Loss of 20 pounds, feels weak and miserable. Gastric analysis: Free HCl, 20; total, 40; no lactic acid or blood.

Röntgenologic Diagnosis. There is no evidence of new growth or indurated ulcer of the stomach or duodenum. The immense dilatation of a section of the small intestine in the region of the descending and horizontal duodenum indicates that there is a chronic obstruction of the small intestine, probably at the duodenojejunal junction. The displacement of the first portion of the transverse colon over a dome-shaped area is suggestive of a tumor, possibly at the head of the pancreas. The röntgenologic evidence indicates surgical procedure in the region of the duodenojejunal junction.

Surgical Findings. The stomach and first part of the duodenum were normal. At the duodenojejunal junction was a large, hard, nodular mass behind the parietal peritoneum, surrounding the aorta, adherent to and causing pressure on the

first portion of the jejunum. There was also a congenital anomaly of the mesentery, resulting in a large hole or pocket, through which a considerable length of the small intestine passed without constriction. Numerous other enlarged retroperitoneal nodes were found along the root of the mesentery. The condition was diagnosed as probably tuberculosis of the retroperitoneal lymph nodes. The adhesions between the large glandular mass and the jejunum were separated, relieving the intestinal stenosis.

FIG. 17.—Clinical diagnosis: definite ulcer of the cap. Röntgenologic diagnosis: obstruction at duodenojejunal junction. Displacement upward of transverse colon by tumor mass. Surgical findings: obstruction at duodenojejunal junction by enlarged tuberculous retroperitoneal glands. Case XVII.

CASE XVIII.—*Clinical History.* M. C.; man. For past eighteen months patient has suffered with severe general abdominal pain, coming on immediately after meals, and lasting an hour or two. Belches gas almost continuously. Has never vomtied. Bowels regular; has small watery stool three times a day, usually after eating. On several occasions has noticed blood in stool, last time three months ago. Has lost about fifteen pounds in eighteen months. Gastric analysis: Free HCl, 20; total, 30; small amount of blood.

Röntgenologic Diagnosis. There is no röntgenologic evidence of new growth or indurated ulcer of the stomach. The

constant irregularity of the cap in all the plates of the prone position, and the irregularity of the pyloric sphincter with the patient in the erect posture indicates that there is a lesion at this point. But considering the symmetry of the cap in a few of the röntgenograms of the erect posture, the lesion should be regarded as spasmodic rather than organic. The cause of the spasm may be found at the appendix or at some distant point. There is no röntgenologic indication for surgical procedure at the pyloric sphincter.

Surgical Findings. No lesion of the stomach or duodenum was discovered. The appendix was thickened, angulated, and imbedded in adhesions.

FIG. 18.—Clinical diagnosis: ulcer of the cap. Röntgenologic diagnosis: spasmodic constriction of the cap. Surgical findings: normal stomach and cap; diseased appendix. Case XVIII.

CASES XIX.—*Clinical History.* C. S.; man. Admitted to the hospital with a diagnosis of perforated gastric ulcer. Acute epigastric pain, severe and protracted vomiting. Vomitus contains blood. Exquisite tenderness and muscular rigidity in epigastric and right hypochondriac regions. Moderate fever. Blood-count, 22,000; polynuclears, 80 per cent. As the symptoms were atypical, no operation was advised, and the patient was kept under observation for three or four days. At the end

of that period all signs of peritoneal irritation having subsided, a series of röntgenograms was made to see if any gastric or duodenal lesion could be demonstrated.

Röntgenologic Diagnosis. There is no evidence of new growth, indurated ulcer or adhesions of the stomach or duodenum. The acute angulation in the first portion of the transverse colon, if permanent, might possibly cause the symptoms of which this patient complains. It is doubtful if the dilatation in the terminal portion of the ileum is of any pathologic significance.

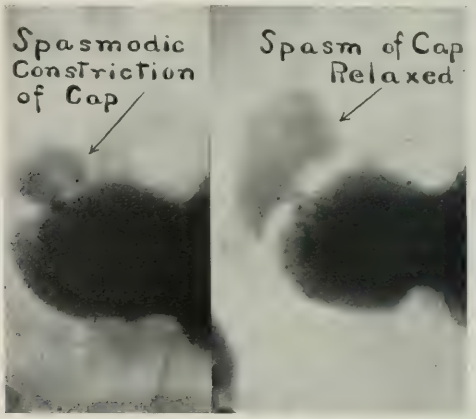

FIG. 19.—Clinical diagnosis: perforated gastric ulcer. Röntgenologic diagnosis: spasmodic constriction of cap, caused by acute angulation in first portion of transverse colon. No organic lesion of stomach or cap. Surgical findings: normal stomach and cap. Adhesions of ascending colon. Case XIX.

Surgical Findings. The stomach, duodenum, and gall-bladder were normal. There was a definite band of adhesions on the ascending colon, causing angulation. The adhesions were divided.

CASE XX.—*Clinical Diagnosis.* Mrs. H., aged sixty-seven years. Indigestion since childhood. Eight years ago epigastric distress, occurring regularly three to five hours after meals, relieved by alkalines or more food. Sour eructations, gas, and loss of weight. Increase of symptoms five years ago with hematemesis. In bed for several weeks. Leube cure. Gastric analysis

at that time: Free HCl. 60; total. 104. Occult blood in stools. String test on two occasions showed stain, indicating gastric ulcer near cardia.

Röntgenologic Diagnosis. There is no röntgenologic evidence of new growth or ulcer of the stomach. Extensive adhesions, probably from an old ulcer or gall-bladder infection, involve the cap. It is evidently adherent to the liver. The stasis of food in the stomach six hours after ingestion corroborates this diagnosis.

FIG. 20.—Clinical diagnosis: gastric ulcer four inches from pylorus. Röntgenologic diagnosis: ulcer of the cap. Surgical findings: ulcer of the cap. Case XX.

Surgical Findings. The stomach was moderately dilated. In the first portion of the duodenum was a large indurated mass, three-quarter inch in diameter, with extensive adhesions to the surrounding parts. A posterior gastro-enterostomy was performed.

CASE XXI.—*Clinical History.* M. O.; man. Two and one-half years ago, having been perfectly well previously, the patient began to suffer from dull, aching pain in the right lower quadrant, coming on about two hours after meals, accompanied by nausea, but no vomiting. The pain generally passes off in about half an hour, and is relieved by taking food. Eating meat, or any heavy

food makes the pain much worse, and such articles of food have been removed from his diet for some time. Has no acid eructations. Bowels are rather constipated, though fairly regular. Has never noticed blood in the movements or tarry stools. Loss of fifty-four pounds in the last two years, though patient feels fairly strong. Gastric analysis: Free HCl, 51; total, 39; no lactic acid or blood.

Röntgenologic Diagnosis. There is a very strong evidence of an ulcer of the cap. The site of the ulcer is evidently about one-quarter inch distant from the pyloric sphincter.

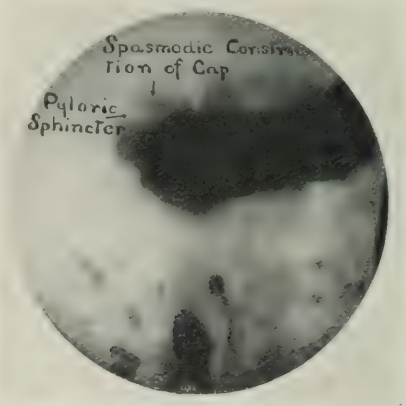

FIG. 21.—Clinical diagnosis: ulcer of the cap. Röntgenologic diagnosis: ulcer of the cap. Surgical findings: normal stomach and cap; diseased appendix. Case XXI.

Surgical Findings. No lesion of the stomach or duodenum was discovered. A chronically diseased appendix, containing a concretion near the tip, was removed.

NOTE.—Case XXI is one of the two cases in which a definite röntgenologic diagnosis was disproved by surgical procedure. The diagnosis of ulcer of the cap was based on too few röntgenograms to justify a differentiation between ulcer and spasmodic contraction. The hyperemia and edema, observed at operation, were undoubtedly the result of a spasm, but no ulcer was found.

CASE XXII.—*Clinical History.* W. W.; man. Seven years ago had distress in the stomach after eating, and vomited frequently. Occasionally vomitus contained blood. Troubled also with acid eructations. Symptoms continued for four years. Since that time has had a vague soreness over the upper abdomen, with gas and occasional vomiting.

FIG. 22

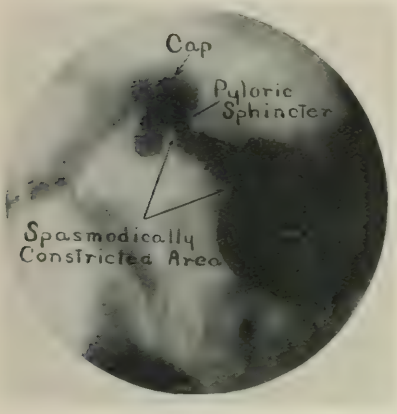

FIG. 23

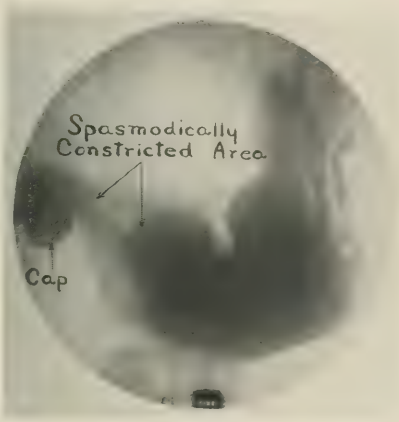

FIG. 22.—Clinical diagnosis: ulcer of stomach or cap. Röntgenologic diagnosis: annular lesion of pars pylorica. Surgical findings: normal stomach and cap. Case XXII.

FIG. 23.—Another manifestation of spasm of pars pylorica, which presented in Case XXII.

Röntgenologic Diagnosis. An annular lesion involves the extreme pyloric end of the lesser curvature. The growth lacks the characteristic indentation of the "finger-print" appearance of a carcinoma, but it should be considered malignant until proven otherwise by microscopic examination.

Surgical Findings. No lesion of the stomach, duodenum or gall-bladder was found. The appendix was removed.

NOTE.—Case XXII is the second of the two cases in which surgical procedure proved that the röntgenologic diagnosis was not correct. The röntgenologic findings had all of the characteristics previously described as indicating spasm, but as the

area involved was accentuated by a circular constriction, the lesion was considered organic rather than spasmodic. A careful matching of the röntgenograms over each other would have prevented this mistake.

Case XXIII.—*Clinical Diagnosis.* H. P.; man. Syphilis twelve years ago. Heavy drinker until seven months ago. Chronic dyspepsia for years, pain after meals, sour eructations, vomiting and soreness in epigastrium. Of late loss of weight (50 pounds). Vomiting of large quantities of foul, undigested food. Gastric analysis: Free HCl, 38; total, 50.

Fig. 24.—Clinical diagnosis: ulcer of the cap. Röntgenologic diagnosis: ulcer of the cap. Surgical findings: ulcer of the cap. Case XXIII.

Röntgenologic Diagnosis. There is no evidence of new growth involving the stomach itself. An obstruction presents at the pylorus, involving either the first portion of the duodenum or the pyloric sphincter, or both. The lesion probably is due to a duodenal ulcer, either old or new. Considering the immense prognathian dilatation of the stomach, and the retention of food, there is no question but that surgical procedure is definitely indicated.

Surgical Findings. The stomach was enormously dilated. A hard, indurated mass, one-half inch in diameter, extended onto

the first portion of the duodenum. A gastro-enterostomy was performed.

CASE XXIV.—*Clinical History.* M. M.; woman. Indigestion since childhood after tiring work. Occasional sharp attacks of colic in upper abdomen of late. Epigastric distress, occurring after meals, and about 11 A.M. and 5 P.M., and after retiring at night. Considerable loss of weight.

FIG. 25.—Surgical diagnosis: ulcer of the cap. Röntgenologic diagnosis: ulcer of the cap. Surgical findings: ulcer of the cap. Case XXIV.

Röntgenologic Diagnosis. There is no evidence of carcinoma or indurated ulcer of the stomach itself. The constant deformity of the cap, viz., the permanent indentation in the upper edge and the pouching of the lower portion, indicates a definite lesion in the upper portion, either from a duodenal ulcer or gall-bladder infection, with the weight of the evidence in favor of the former.

Surgical Findings. The stomach was found to be normal. A small, shot-like induration presented on the posterior wall of the duodenum, one-quarter inch from the pylorus. A gastro-enterostomy was performed.

CASE XXV.—*Clinical History.* J. P.; man, aged forty years. The patient had dysentery in 1899. Since 1905 has had chronic

indigestion, hunger pains, occasional severe pain in epigastric area after eating, with more or less soreness in appendicular region.

Röntgenologic Diagnosis. No evidence of new growth or indurated ulcer of the stomach or duodenum can be detected. The contraction of the cap and the extreme pyloric end of the stomach is probably due to a spasm or possibly to adhesions. The flattening of the left side of the ascending colon, the incomplete distention of the cecum, the insufficiency of the ileocecal

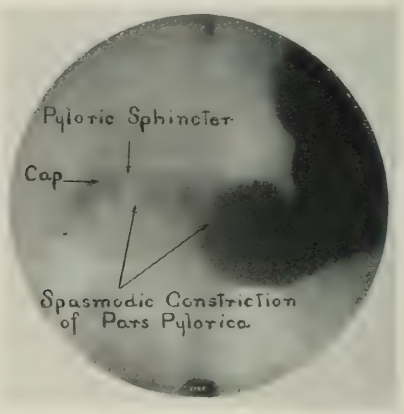

FIG. 26.—Clinical diagnosis: gastric or duodenal lesion. Röntgenologic diagnosis: spasmodic contraction of cap and pars pylorica. Surgical findings: normal stomach and duodenum. Case XXV.

valve, with the distended coils of small intestine pressing on the left side of the ascending colon up to the region of the gall-bladder, are sufficient to cause the spasm of the stomach and cap.

Surgical Findings. The stomach and duodenum were normal. Two small adhesions passed from the summit of the gall-bladder and duodenum to the liver. An adherent, thickened, and angulated appendix was removed.

CASE XXVI.—*Clinical Diagnosis.* N. R.; woman, aged twenty years. Six months ago the patient first began to complain of pain in epigastrium, coming on two or three hours after meals,

gnawing in character, and relieved by taking food or bicarbonate of soda. Three months later the pain began to be associated with attacks of vomiting, which always relieved the pain. Vomitus consisted of food recently taken, and twice contained a little blood. Four months after onset of symptoms, patient entered hospital and was treated for three weeks with a diet. Diagnosis: Gastric ulcer. After leaving hospital, was free from pain until a week ago, when it returned with occasional vomiting. Loss of sixteen pounds in last six months. Gastric analysis: Free HCl, 17; total, 36; no lactic acid or blood.

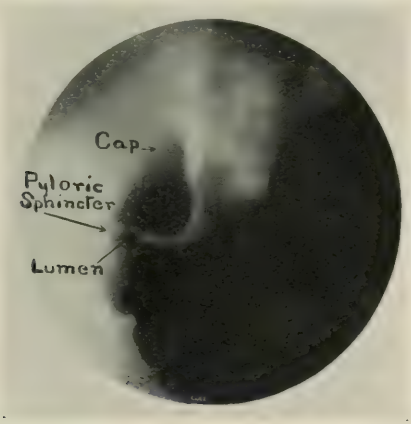

FIG. 27.—Clinical diagnosis: ulcer of the cap. Röntgenologic diagnosis: functional derangement of gastric digestion; no organic lesion of stomach or cap. Surgical findings: normal stomach and cap. Case XXVI.

Röntgenologic Diagnosis. The röntgenographic findings justify a negative diagnosis of new growth or indurated ulcer of the stomach or duodenum. That there is an extreme functional derangement of the stomach is evident from the erratic motor phenomena. When the food was first administered there was a great atony, and no evidence of peristalsis. A few minutes later the peristalsis became hyperactive, and the food was rapidly expelled through a wide-open pylorus for a short time, and progressed at great speed through the cap, duodenum, and into the jejunum. The two and one-half-hour röntgenograms show

that the stomach is perfectly normal in position, and the cap well distended. But there is no evidence of any food passing through the duodenum or jejunum. In the five and one-quarter-hour röntgenograms, a moderate gastric retention is seen, with no evidence of the pars pylorica, cap, duodenum, or jejunum. I am unable to determine the cause of this functional disturbance.

Surgical Findings. The stomach, duodenum, and gall-bladder were found to be normal. A thickened and congested appendix, containing a large amount of fecal matter, was removed.

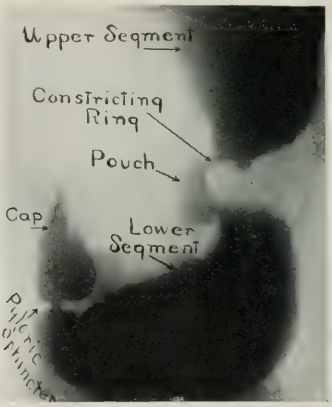

FIG. 28.—Clinical diagnosis: gastric lesion of three months' duration. Röntgenologic diagnosis: hour-glass stomach. Surgical findings: hour-glass stomach. Case XXVII.

CASE XXVII.—*Clinical History.* S. B.; woman. For the past three weeks patient has complained of almost constant epigastric pain, eructations, and nausea. On the day before admission she had an attack of severe pain, radiating to the side and back. The pain has no relation to eating and is relieved by vomiting, which occurs frequently. The vomitus is usually small in amount, greenish, and occasionally blood streaked. The patient has never been jaundiced. She believes she has lost some weight. Gastric analysis: Free HCl, 0; total, 26; lactic acid, 0. Blood-positive. Blood-analysis: Hemoglobin, 80 per cent.; red-blood cells, 5,000,000; white-blood cells, 12,000.

Röntgenologic Diagnosis. There is evidence of an organic hour-glass constriction, with a pouching or perforated ulcer on the lesser curvature, or perhaps a double constriction. Personally, I have seen these lesions occur in unquestionable cases of carcinoma, and I am therefore not prepared to state that it is indicative of a non-malignant condition.

Surgical Findings. On operation it was discovered that the entire central area of the stomach was distorted by a massive induration, extending from the lesser curvature to the greater, more marked on the posterior surface, in which situation the induration also extended to the pancreas. This resulted in an hour-glass contraction of the stomach, the upper segment of which was concealed beneath the costal border. The lower pouch lay in its normal position. It was impossible to do a gastro-enterostomy with the upper pouch on account of its high position. A gastrogastrostomy was therefore made on the anterior surface of the stomach by the suture method.

In summing up the evidence furnished by this series of 27 cases, it will be seen that of the 22 cases in which a definite diagnosis was made by the Röntgen method, subsequent operation proved that in 20 instances this diagnosis was correct, and in 2 it was incorrect. In 11 of these cases the diagnosis was a negative one regarding the presence of a gastric or duodenal lesion, although the clinical history so strongly suggested ulcer or carcinoma as to justify exploratory operation. In not one of these cases was an organic lesion found to exist. In the five instances in which the röntgenologic diagnosis was not definitely stated, owing to incomplete observation, or unusual findings which could not be definitely interpreted, and concerning which only an opinion was expressed as to the probable lesion present, the opinion proved to be correct in four instances and incorrect in one instance. In other words, in this particular series, a correct diagnosis was made by serial röntgenography in 80 per cent. of the cases. The information obtained from this series has been invaluable to the röntgenologist in his interpretation of unusual findings, and the experience gained from the hearty

coöperation of the surgeon will greatly increase the accuracy of this method of examination.

The objections to the method are obvious. It requires considerable time, and is moderately expensive. If it could be shown that a simpler method would give equally good results, that method would undoubtedly become the popular one. In the opinion of the writers, however, serial röntgenography will give more accurate information concerning lesions of the stomach and duodenum than any other method employed at present.

PYLORECTOMY AND PARTIAL GASTRECTOMY, OR EXCISION OF THE ULCER-BEARING AREA IN THE TREATMENT OF GASTRIC ULCER

By WILLIAM L. RODMAN, M.D.
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Fourteen years ago, in a paper read before this Association, I advocated a more radical treatment for gastric ulcer than had been hitherto practised. I was led to do so, not from theoretic considerations alone, but after a careful study of the few cases published, and others reported to me in an extensive correspondence with American and foreign surgeons, giving the clinical result following partial gastrectomy and pylorectomy. Nearly all of the forty patients so treated had been operated upon with the belief that they were suffering from cancer, and hence demanded more radical measures than pyloroplasty and gastro-enterostomy, then so much in vogue in the surgical treatment of ulcer. It was also ascertained that the more formidable procedures of partial gastrectomy and pylorectomy had not only been followed by far better clinical results, but the operative mortality was little, if any, more (15 per cent.) than the acknowledged risk inherent to pyloroplasty and gastro-enterostomy at that time. Nevertheless, I felt that partial gastrectomy and pylorectomy, especially the latter, might yield a heavier mortality than either pyloroplasty or gastro-enterostomy, and that the favorable showing then made for the more radical measures was, perhaps, fortuitous, or due to the surgeons having been more ready to report successful instances of a new operation than unsuccessful ones. But this much was reasonably certain —radical treatment, or excision of gastric ulcers, did prevent subsequent hemorrhage, perforation, subphrenic abscess, hour-

glass stomach, and malignant degeneration, while neither pyloroplasty nor gastro-enterostomy assuredly prevented any of them. Therefore, an operation which gave assurance against such future disasters and which, moreover, left the stomach in a much better condition for the performance of its normal functions, had a claim for consideration, even though its mortality were far greater than the uncertain, and oftentimes at most, palliative procedures. It was later made apparent that pyloroplasty gave such unsatisfactory results, operative and clinical, that it fell into general disfavor and has hardly been heard of in the past ten years. I refer, of course, to the Heineke-Mikulicz operation which was so generally practised between 1895 and 1905.

The operation of Finney, however, introduced in 1902, and based upon sounder physiological, pathological, and surgical grounds, has not only maintained its place, but grown in favor and seems particularly applicable in the treatment of duodenal ulcers.

That gastro-enterostomy was not, for many years at least, followed by the best operative and clinical results is only too clearly evidenced by the many changes made necessary in its technique; they are too numerous to mention. The most that can be said at this time is that surgeons very generally prefer the posterior to the anterior anastomosis, and that the long loop of twelve or more inches has been gradually shortened on account of regurgitant vomiting, until there is usually no loop at all. Mechanical devices have been abandoned for direct suture, but the method of approximating the stomach and jejunum, the length of the opening between them, and the many nicer points of detail vary widely with different operators.

Everyone, from the time gastro-enterostomy was first practised, has been made to observe that patients with a closed, or partially closed pylorus, do better than those in whom it has been left patent; and yet, notwithstanding the many operative procedures to secure pyloric exclusion, none of them has yielded entirely satisfactory results. A majority of the one hundred surgeons with whom I communicated, and who expressed themselves

upon this point, withhold their approval of the principle; others speak pessimistically of the clinical results in the cases they have observed; while others still commend the principle, but do not believe that a satisfactory method has yet been discovered.

After carefully reviewing the statistics recently furnished me I am impressed with three things: First, that the operative mortality following gastro-enterostomy has not been less than 5 per cent.; second, that the end-results are frequently disappointing to the surgeon and disastrous to the patient, making his second estate worse than his first; third, that a number of perfectly satisfactory gastrojejunostomies, from an operative point of view, the patients remaining well for a year or longer after operation, were followed by malignant disease and death. As one of the members of this Association expressed it, "Two-thirds of the patients who survive gastro-enterostomy are cured, one-sixth are bettered, while the remaining one-sixth are rank failures, no better, perhaps worse, than before operation." Some of the supposed ulcers may have already undergone cancerization before the gastro-enterostomy, but in others the evidence of malignancy was postponed several years. This has been notable in the reports of Gerster, Mayo, Lilienthal, Robson, and many others.

Gerster writes me as follows: "Gastro-enterostomy in ulcers yielded to me, on the whole, good results—very good operative results; but there were a number of clinical failures due to the development of cancer in the ulcers. Resection of the ulcer-bearing area is the ideal method of treatment, and should be applied wherever topographic and technical considerations do not forbid."

Dr. Lilienthal writes: "Gastro-enterostomy in its various forms does not give me satisfaction, and in three cases which I happen to remember just now, carcinoma developed at the pylorus years after the gastro-enterostomy; in two cases the stoma closed. I do not approve of the various exclusion methods, and can prove by *x*-ray studies that in many of these cases patency is reëstablished."

W. J. Mayo, our distinguished president, wrote me as follows in 1908: "The main field for the Rodman operation as we find it, is an inability at the operating table to tell a carcinoma from an ulcer. In three cases out of four, when we remove a suspicious ulcer, it proves to be a carcinoma, and a number of cases, after gastro-enterostomy for supposed ulcer, have developed carcinoma so quickly as to make it almost certain that it had existed at the time of operation." Only a few days since I sent him the above quotation from his former letter, asking his permission to use it again, or, if he wished, to revise it so as to make it conform to his present views and practice. He replied that he had no change to make, as it was just as true today as when it was written.

Have we not, in the above-expressed views and practice, the only explanation of the remarkable results achieved at the Rochester clinic in both ulcer and carcinoma of the stomach? At no other clinic in the world have their results been approached in the treatment of the latter affection, showing 25 per cent. of five-year cures and 36+ per cent. of three-year cures. Such results would not be possible if only lesions macroscopically cancerous were considered.

On account of the number of carcinomata following gastric ulcers in his practice (59.3 per cent.), Mayo Robson, one of the earliest and ablest exponents of gastric surgery, said in 1904, that excision of the ulcer-bearing area must be more frequently done in the future. Furthermore, of 112 posterior gastro-enterostomies performed by Mr. Robson for ulcer, four patients died subsequently of carcinoma. It developed in one patient at the end of a year after a perfectly successful gastro-enterostomy; in one after two and a quarter years; in one after two and a half years, and in the fourth after three and a half years. All enjoyed good health between the gastro-enterostomy and the onset of cancer symptoms. The time intervening renders it unlikely that a mistake in diagnosis could have been made in any but the first case. There are other cases in this series where it seems more than probable that death was due to cancer.

Bevan of Chicago, informs me that he has performed about a dozen pylorectomies for ulcer where a laparotomy diagnosis of probable carcinoma was made. Although all the patients recovered, he believes the more radical procedure should be reserved for the worst cases and then, perhaps, performed in two stages. He has found gastro-enterostomy, on the whole, satisfactory in the treatment of gastric and duodenal ulcers, but has excised both with good results.

The following communication was received from G. E. Brewer: "In reply to your note, I can say that I have never done a pylorectomy for benign ulcer. I thoroughly approve of your suggestion and teach it. I have, a number of times, done a pylorectomy for an induration following an ulcer history, but in every instance the growth was found to be malignant. In only one instance have I removed a large saddle ulcer of the lesser curvature. This case gave us a very satisfactory result. During the past six weeks I have had two cases in which I expected to do an excision, thinking the growth was benign. In one instance it was inoperable and found to be syphilitic, and in the other carcinoma."

R. C. Coffey, of Portland, who has done much operative and experimental work in the upper abdomen, says: "Concerning gastric ulcers, I will state that I am doing the Rodman operation more frequently all the time, have done two within the past month. I believe I have done something like ten previous operations, making twelve, with one death. I have now reached the rather definite conclusion that when a patient is in good condition and the ulcer is near the pylorus, either in the duodenum or stomach, and has not perforated, or adhered to the head of the pancreas, I do pylorectomy. If there has been a duodenal perforation and the duodenum has adhered to the head of the pancreas, I do von Eiselsberg's unilateral exclusion. I think McCarthy's recent paper in the February *Archives of Internal Medicine* is more convincing still, that we should remove an ulcer when possible."

There are many others from whom I could quote, all to the

same effect. We have shown, I think, that even the most experienced surgeons cannot make an accurate diagnosis in chronic gastric lesions. That this difficulty will assuredly be increased in hosts who have reached or passed middle age, the time when both ulcer and cancer are most common, cannot be questioned. Is it not, therefore, true conservatism to take into consideration potential dangers such as hemorrhage, perforation, subphrenic abscess, disabling adhesions, and, greatest of all, cancerous implantation upon the base of the ulcer, and to anticipate and prevent all by a radical operation, instead of doing one which may at most prove palliative, and that for a time only? The only way to view this difficulty, it seems to me, is to ascertain if a radical operation, which removes the lesion, can be instituted with less risk to the patient than that which is inseparable from the disease itself. In chronic ulcers there would seem to be no difficulty in answering this question, as a conservative estimate of the mortality following medical treatment, and admitted by medical authorities, is not less than 25 per cent. If we separate excision and pylorectomies we find that the former yield a mortality of 1.75 per cent. (171 operations, 3 deaths), which is less that that following gastro-enterostomy; 205 pylorectomies were followed by 18 deaths, or 8.7 per cent. It must be remembered that these statistics include all operations reported during the past fifteen years, and represent the experience of many surgeons, some of whom have done very few operations. In 376 radical operations performed by all of the surgeons communicated with the mortality was 5.6 per cent., or less than that from hemorrhage alone, and one-half that following perforation, not to mention the additional risks of subphrenic abscess, disabling adhesions resulting in hour-glass stomach, and that indefinite, intangible, but ever-increasing danger, malignant degeneration of the ulcer. So frequent is the last-mentioned complication that it would seem now the duty of the surgeon to remove the lesion when it is practicable and does not entail too great operative risk, for a considerable majority of those comunicated with have expressed themselves most positively upon this point.

Furthermore, we should realize that the most recent and trustworthy statistics (Hoffmann, statistician of the Prudential Insurance Co.) show that there are 75,000 deaths from cancer in the United States annually; that 35 per cent., or more than 26,000, are caused by carcinoma of the stomach (Virchow) and, moreover, that those surgeons most experienced in gastric surgery have reported, after accurate clinical and microscopical observations made at their respective clinics, that a percentage varying from 59.3 (Robson) to 71 per cent. (W. J. and C. H. Mayo) of gastric carcinomata are preceded by ulcer.

Sir Berkeley Moynihan, who was my guest, in 1903, did not hesitate to tell me plainly—a trait so characteristic and admirable in the English—that I greatly overestimated the frequency of carcinomatous change in gastric ulcers, had so changed his views within the next five years as to publish in 1908 that 72.1 per cent. of the operations he had recently done for gastric cancer had been preceded by a well-marked history of ulcer varying from three to twenty-six years.

The observations of Moynihan and Robson, astute clinicians as they are, are entitled to much weight, though unsupported by microscopical examination.

No one who has visited the clinic at Rochester, a privilege I have many times enjoyed during the past fifteen years, has left there without being impressed with one fact, that pathology is used as it should be, as the true handmaiden to surgery. Every tumor or lesion removed is at once examined by most competent microscopists and an immediate report made to the operator and onlookers. Moreover, the frozen section reports are later confirmed by serial sections. In this way, and in this way only, in my opinion, will the patient get that to which he is entitled. The time for guessing has passed, as we have already shown that the most experienced men confess their inability to make an accurate diagnosis, even when the lesion is inspected, palpated, and scrutinized from every view-point. The presence of enlarged lymphatic glands does not necessarily mean cancer, as they may be inflammatory, and the absence of such involve-

ment most certainly cannot rightly be construed as always, or usually, indicating a benign process, and to await positive evidence of cancer is to allow the propitious time for surgery to pass. The microscope, and it only, can tell what pathological changes have occurred, and the patient has a right to insist that his surgeon avail himself of every means at his command to obtain accurate information, at the time of operation, so that the right procedure can be instituted, and that he, as well as others, may profit thereby. That too many patients with potential or actual cancerous lesions in the stomach, breast, gall-bladder, intestines, prostate, and other organs pay the price of involuntary sacrifice to incomplete surgery cannot be questioned.

It would seem clear that more radical measures than hitherto usually practised should be employed, so that cancer in its early stages may be cured, or better, prevented altogether. Never at any time in the world's history has the cancer menace been so generally appreciated as now; never has there been such intelligent coöperation between the medical profession, philanthropists and laity to discover its cause; and never, certainly, have surgeons been so stimulated and quickened to act promptly themselves and to urge medical confrères to do likewise in combating this scourge. But recognizing, as all do, the strictly local nature of carcinoma primarily, and as well the desirability of acting during the precancerous stage when considering the breast, lip, tongue, gall-bladder, intestine, prostate, etc., there does not seem to be so keen, nor so general an appreciation of the frequency of gastric cancer, nor of its close association with ulcer as an etiological factor. And yet both facts have been proclaimed from the very housetops by clinicians and pathologists. We have already mentioned the former, and it is only necessary to refer to the work of Cruveilhier (1839), Dittrich (1848), Rokitansky (1849) Hauser (1903), Futterer (1892), Ssapeshko (1902) Stich (1903), Oettinger (1903), Jeddlicka (1904) and a host of others, such as Zenker, Klausa, Sonnichen, and Schmincke, to show that a percentage of gastric carcinomata varying from 26.6 (Jeddlicka) to 90 per cent. (Ssapeshko) give

positive microscopic evidence of having been preceded by ulcer. One of the number (Jeddlicka) also made clear, from pathological investigation in 1904, what I had believed in 1900 from the scant clinical evidence then forthcoming, that gastric ulcers in other parts of the organ than the pylorus and its proximity do not undergo cancerization. He says, "It should now be noted that all the ulcer-carcinomas were encountered in the pylorus, whereas ulcers situated in other portions of the stomach, and which were examined, did not reveal a single carcinoma." In 1905 I encountered one patient with ulcer-carcinoma in the middle of the stomach and found a similar case reported by Cackovic. Both have been reported and others have doubtless occurred. It is, however, reasonably certain that ulcers in the larger and more expanded four-fifths of the stomach are not only very much less frequent, comprising as they do only 20 per cent. of the total number of gastric ulcers, but rarely undergo malignant change. Eighty per cent. of all ulcers are found in the pyloric fifth. The greater irritation to which ulcers at the pylorus or in the pyloric antrum are subjected and the forcible impact of the large amount of acid chyme upon them during digestion would seem to furnish adequate reason why they are so prone to undergo cancerization. They, too, are more likely to be followed by perforation and hemorrhage, and when the latter occurs, on account of the large vessels in this situation, it is apt to be severe. Therefore a more radical treatment of such ulcers is called for, and pylorectomy which removes largely the ulcer-bearing area is the operation of choice, provided that the pyloric end of the stomach can be easily mobilized and the patient is in good condition.

It is questionable if it should be done in the presence of acute perforation or severe hemorrhage. Many of the fatalities reported have been due to too radical surgery in spite of these grave complications. I have only once undertaken pylorectomy for a large acute perforation on the anterior wall of the pylorus, which occurred just after a hearty luncheon. The escape of gastric contents was marked, as the opening was large and,

ragged. My patient was a robust young man of twenty-two, and as the sutures would not hold because of the necrotic tissue around the perforation, resection of the pyloric end of the stomach supplemented with a posterior gastrojejunostomy was done as a *dernier ressort*. I have never had a patient do better in every way even after simple gastro-enterostomy. I have also performed pylorectomy after there had been moderate chronic hemorrhages, but I should hesitate to do so in the presence of even moderate acute hemorrhage, and would not do so at all during a severe hemorrhage or the ensuing shock. In such circumstances I have for the past twelve years depended upon morphia and atropia hypodermically, and very hot water, 130° F., cautiously introduced through a tube.

I was led to do this first in 1902 after the most severe and repeated gastrorrhagias I had ever witnessed. The patient was pulseless, delirious, and exsanguinated to such a degree that recovery seemed impossible. I did not believe a human being could lose so much and live. The room in which she lay resembled an abattoir; the night superintendent, nurses, and my assistant were covered with blood when I arrived. Before I came my assistant, Dr. S. C. Burns, had given morphia, ice, and astringents of every description without result. In my desperation 8 ounces of hot water was introduced through a stomach-tube. Both of us remained in the hospital all night and one was constantly on watch. The vomiting and bleeding were immediately checked by the hot water. It has never failed me in about twenty cases. Dr. W. H. Thomas, one of my assistants, has had a similar experience of it in our services at Blockley, and has recently reported his cases.

Within a fortnight I saw a young man, aged thirty-two years, with Dr. Paul R. Correll, who estimated that his patient had lost eight pints of blood through vomiting; he subsequently lost considerably more by the bowels, and he was pulseless when I saw him. He never vomited after he was given hot water, and was removed to the hospital where he is now improving rapidly, and being prepared for operation.

Conclusions. 1. If the ulcer or ulcers are situated at, or near the pylorus, as they are in about 80 per cent. of all cases, and the pyloric end of the stomach and proximal portion of the duodenum can be easily mobilized, pylorectomy, which gets rid of the existing ulcers and prevents future ones to a large extent, removing, as it does, four-fifths of the ulcer-bearing area, is certainly the operation of choice. The frequency with which hemorrhage, perforation, and cancer, especially the latter, follow gastro-enterostomy, show it to be wholly inadequate. Moreover, the radical operations of excision and pylorectomy are only slightly more dangerous, while far more beneficent in every way than gastro-enterostomy.

2. If, however, the converse obtains, the stomach and duodenum being bound down by adhesions to adjacent viscera, such as the pancreas, liver, gall-bladder, transverse colon, etc., simple gastro-enterostomy, the anastomosis being made about the middle of the stomach, should be practised. If the symptoms are not relieved within a reasonable time, then pylorectomy may be performed more safely. Before such a step is taken the operator should be assured that the gastro-enterostomy is patent and functionating.

3. The operation can also be done in two stages in those patients not in good condition, whether it be from hemorrhage, anesthetic, or other cause. It is often best to perform pylorectomy for cancer in two stages, and practically the same conditions may confront the surgeon in ulcer; but it will be much less frequently the case.

4. Gastric ulcers, duodenal as well, are more frequently multiple than is appreciated; some excellent authorities state that such is usually the case. With the number and chronicity of ulcers potential dangers are increased, and radical measures are more urgently called for.

5. Ulcers away from the pyloric end, that is, occupying the expanded four-fifths of the stomach, should preferably be treated by partial gastrectomy or removal of the ulcerated area. Although such ulcers rarely undergo cancerization, they frequently

bleed and perforate, both of which dangers are increased by the freer movements of this portion of the stomach during respiration. Moreover, on this account protective adhesions are less apt to form about them if we except the lesser curvature, which is relatively immobile. If simple excision is practicable it should be done, as it carries with it a smaller mortality, 1.7 per cent., than gastro-enterostomy.

6. In some cases it may be wise, though it is not usually so, to supplement excision by gastrojejunostomy. It all depends upon the location and size of the ulcer and whether or not the stomach can presumably carry on its functions without irritating, stretching, or otherwise interfering with the line of suture.

A METHOD OF SUBTOTAL GASTRECTOMY

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I am emboldened to bring the operation described in this paper to the attention of the Association because of the difficulties that are sometimes experienced, after partial removal of the stomach, in joining the first segment of the jejunum with the posterior wall of the gastric stump, and because of the obvious disadvantages of the simpler but more dangerous anterior, antecolic, long-loop gastro-enterostomy. Billroth's first method (end-to-end anastomosis between the stomach and the duodedenum) and Kocher's implantation of the open end of the duodenum into the posterior wall of the stomach are, I imagine, rarely considered at the present time, owing to the great tension exerted on the anastomotic sutures, especially if one removes as much stomach as is demanded in the modern operation for carcinoma of the pylorus.

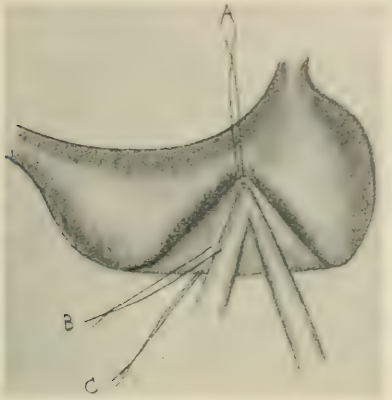
The method of subtotal gastrectomy that I desire to submit for criticism consists in removing the diseased segment of stomach from left to right, after performing an end-to-side anastomosis between the lower portion of the incision, which amputates the stomach and the upper part of the jejunum, the operation being so conducted that the suturing necessary to unite the stomach to the intestine is completed before either viscus is opened.

The gastric artery is doubly ligated at the upper end of the proposed line of section of the stomach, and divided between the ligatures. The gastrohepatic omentum is tied in sections

and severed. The left gastro-epiploic artery is ligated about one-half inch on each side of the lower end of the proposed line of section of the stomach, and the segment of artery between the ligatures excised. The gastrocolic omentum is tied and cut, from a point about two inches to the cardiac side of the selected line of gastric amputation to the duodenum. The transverse mesocolon is drawn taut, without pulling the colon from the abdominal cavity, and a hole torn in this membrane, from the upper side, within the arc of the midcolic artery. The upper end of the jejunum immediately bulges into this opening and is drawn into the lesser peritoneal cavity. A suture is passed through the greater curvature of the stomach, midway between the ligatures on the left gastro-epiploic artery, and through the antimesenteric border of the jejunum, at a point about five or six inches below the origin of the jejunum, the distance varying according to the degree of dilatation of the stomach. By pulling upward on this suture the posterior wall of the stomach and the upper segment of the jejunum are brought in contact. A suture uniting the posterior wall of the stomach to the intestine is inserted about three inches above the original suture, and a third suture is passed through the posterior wall of the stomach alone, an inch or more above the second suture (Fig. 1), both of these sutures being on the line through which the stomach is to be amputated. Two sutures are now placed in the anterior wall of the stomach, at points corresponding to the upper sutures in the posterior wall (Fig. 2). The point at which each anterior suture is to be inserted may be determined easily by grasping the stomach with the left hand in such a way that the index finger presses the point of insertion on the posterior wall up against the corresponding point on the anterior wall, which point is marked by the thumb. Suture *A* is now drawn upward and to the right (*i. e.*, toward the patient's right shoulder), sutures *B* and *D* downward and to the left (*i. e.*, toward the patient's left hip) and tied together, sutures *C* and *E* likewise downward and to the left and tied together (Figs. 3 and 4). The upper segment of the jejunum is thus surrounded by the

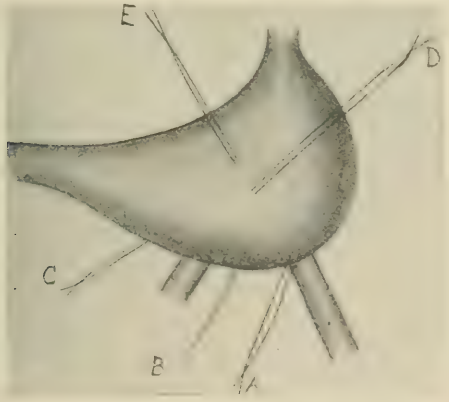
stomach, the anterior wall of which lies against the right side of the bowel, the posterior wall against the left side of the bowel.

FIG. 1



Between sutures *B*, *D* and sutures *C*, *E* the anterior and the posterior walls of the stomach are in contact, which contact is made permanent by the introduction of a seroserous suture of celluloid thread, which suture is continued from *B*, *D* to *A*.

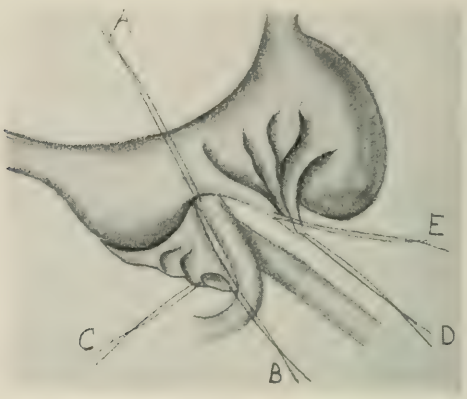
FIG. 2



uniting the anterior wall of the stomach to the bowel, and from *A* back to *B*, *D*, uniting the posterior wall of the stomach to the

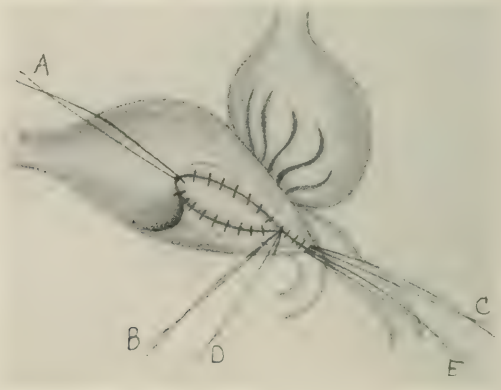
bowel (Fig. 4). This seroserous suture is overlaid by a through-and-through catgut suture, and sutures *B* and *D* cut off short.

FIG. 3



The greater curvature of the stomach is grasped with forceps about one-half inch from *A* (Fig. 5), and the lesser peritoneal cavity filled with gauze. The portion of the antimesenteric border of the intestine exposed between the rows of sutures is

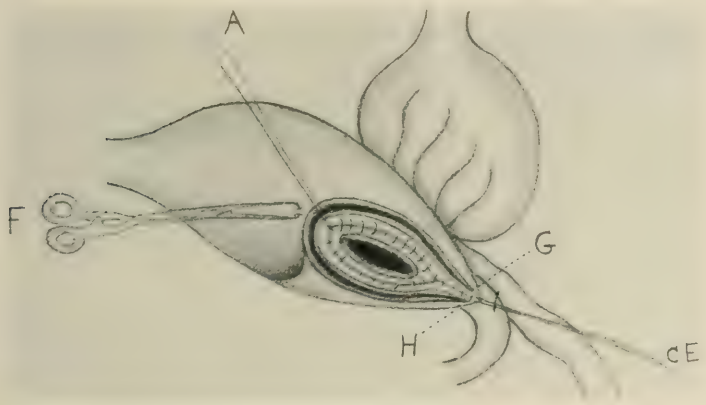
FIG. 4



excised, and an incision made in the stomach close to the suture line, beginning at *G*, passing between *A* and *F*, and ending at

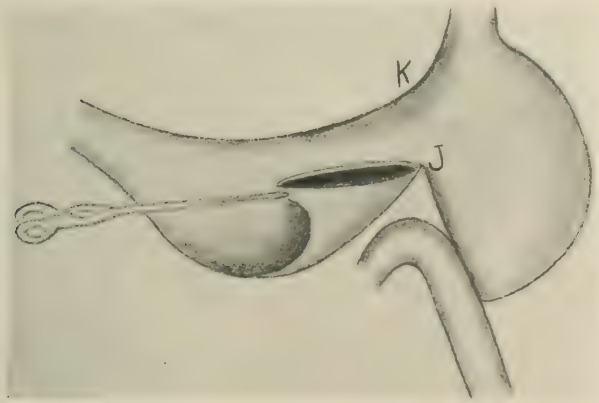
H (Fig. 5). After ligating any vessels which have not been caught by the sutures, thread *A* is cut and the stomach allowed

FIG. 5



to straighten itself (Fig. 6). A clamp is placed across the stomach to the pyloric side of the line of section, and the amputation completed after approximating the anterior and the posterior walls of the stomach, between *J* and *K* (Fig. 6), by several

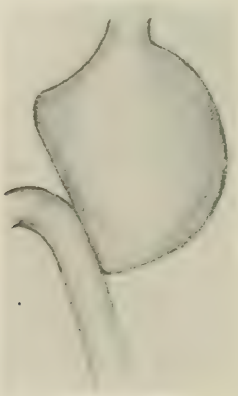
FIG. 6



through-and-through sutures of catgut, which sutures are buried by an inversion seroserous suture of celluloid thread. It is well,

but not essential, to insert the uppermost inversion suture before completing the amputation of the stomach, since by pulling on this suture the raw edges, which are already inverted at the lower end (*K*, Fig. 6), recede between the serous coats, which can then be rapidly sutured (Fig. 7). The pyloric segment of the stomach is drawn from the abdominal cavity and turned over on the patient's right hypochondrium, the superior pyloric and the gastroduodenal arteries secured above and behind the pylorus, the duodenum severed between ligatures, and the duodenal stump inverted. The edges of the rent in the transverse mesocolon may be attached to the jejunum or, if there is much gastrectasia, to the stomach.

FIG. 7



The operation just described may be performed in any case of gastrectomy in which posterior gastro-enterostomy is applicable, and perhaps in some in which, owing to the small size of the gastric stump, posterior gastro-enterostomy would be injudicious. With equal practice in the two operations the newer one should be less difficult and more rapid; there is less cutting to be done, consequently less suturing; the lower part of the incision for amputating the stomach serves at the same time for the anastomotic opening. In the newer method the anastomotic opening is at the lowest part of the stomach, and all of the anas-

tomotic sutures and a portion of the sutures which close the stomach above the anastomosis, are in place before either the stomach or the intestine is opened. When the incisions are made the cut edges are in view, unrestrained by clamps, so that hemostasis may be made absolute. Gastro-enterostomy with clamps is often followed by bleeding, and sometimes by a hemorrhage which necessitates reopening of the abdomen. I suspect also that the bruising exerted by clamps may be partly responsible for some of the cases of non-union of the sutured surfaces after gastrectomy for carcinoma, and perhaps also for some of the ulcers which occur at or near the line of anastomosis after gastro-enterostomy for hepatic ulcer. Aside from these disadvantages which attend the use of clamps, they are always in the way, and occasionally, during gastrectomy, the one placed on the cardiac end of the stomach slips, especially when it is turned to facilitate suturing. If the stomach is well cleansed by gastric lavage previous to operation, if the patient is not allowed to retch during operation, and if the guide sutures are kept taut, and the site of anastomosis is well elevated above the incision in the abdominal wall, there is no danger of leakage from either the stomach or the intestine in the method I have just described. With this method there is less tension on the anastomotic sutures and less tendency to kinking than when the jejunum is anastomosed to the posterior wall of the stomach at a point which must, of necessity, be farther to the patient's left. In posterior gastro-enterostomy after partial gastrectomy there may be, from a theoretic standpoint, some danger that the gastric incision for anastomosis, which is usually parallel or nearly parallel with the sutured edges of the stomach at the line of amputation, may interfere with the blood supply to these sutured edges.

I have rehearsed on the cadaver a number of times the operation detailed above, and found that it could be done without difficulty, even when the stomach was greatly distended with gas, but that under these conditions the manipulations were facilitated if the stomach were punctured with a hypodermic needle and the gas allowed to escape.

DISCUSSION ON PAPERS DEALING WITH SURGICAL LESIONS OF THE STOMACH

Dr. Fred B. Lund, Boston.

I have been very much interested in the *x*-ray diagnosis of lesions of the stomach, and it has seemed to me that in the cases I have studied in conjunction with my colleagues it is only in the advanced cases that we could make a diagnosis of carcinoma by skiagraphic radiography as we have used it. Dr. George, of Boston, claims, as do Dr. Cole and Dr. Brewer, that he can tell in 90 per cent. whether the condition is one of ulcer or one of cancer, and I would be willing to grant that if the condition were advanced. I have three pictures of a recent case in which an early carcinoma of the stomach was excised, which illustrates some points. The patient, a man aged sixty-five years, had blood in his stools and was in poor condition, had diminished HCl, and other signs of gastric ulcer. I was unable to tell whether it was an ulcer or a cancer from the *x*-ray, although three pictures were taken. I therefore cut down on this induration at the pylorus, which proved to be not nearly so marked as many I am accustomed to leave behind, and did a gastro-enterostomy. The area showed a shallow ulcer, apparently a chronic ulcer. I took the specimen to Dr. Mallory, who said it was a chronic ulcer, but the microscope showed it to be early carcinoma. There was not a single gland involved, and the case was, as is evident, a most favorable one for operation. I therefore believe that where we can remove these ulcers simply and safely they should certainly be removed.

Dr. A. J. Ochsner, Chicago.

In connection with the discussion of differential diagnosis of ulcer and cancer, for some time we have made some very interesting experiments which I believe will be borne out by an analysis of the different things that have been said and written about this subject. In every patient that comes under my care, first I take the history and make a physical examination and a written diagnosis, which is placed in a sealed envelope. The history is taken again by the roentgenologist and chemist, who makes first the chemical and then the *x*-ray examination. In a considerable number of cases we have found that where my diagnosis is based on a physical examination and the history is positive that the *x*-ray examination and the chemical examination are also likely to be positive, but this has been possible only where he obtained the history and made a physical examination before

making the *x*-ray and the chemical examination. The *x*-ray examination and the chemical examination without a history seemed to be almost useless, so that so far as the cases which are clear from the first standpoint are concerned there is practically never any doubt. In the marginal cases some 20 per cent., in which the diagnosis based on the first two elements is doubtful, the diagnosis by means of the *x*-ray and chemical examination is also likely to be doubtful. The three methods taken together are, however, likely to clear up some of these doubtful cases. We have made it a practice to always operate these cases in the presence of the roentgenologist and chemist, and I believe that in time a certain number of difficult cases will be cleared up by combining the three methods. It is in the difficult, doubtful cases that these two latter methods are likely to be of the least use, so that simply because they are positive in the simple cases does not make their value so great in the doubtful cases as one might be led to believe.

Dr. Arthur Dean Bevan, Chicago.

I want to say a word in regard to handling the work that has been presented here today as a piece of clinical research. A group of three or four of us have been attempting to handle these cases of lesions of the stomach, duodenum, and bile tracts for the last few years as clinical research, and have attempted to obtain the evidence from the internist so far as diagnosis is concerned, and from the roentgenologist and from the surgeon, and then have the internist and roentgenologist follow the case through to the exploratory operation. The attempt is made to have the internist offer all of the clinical evidence, submit a definite diagnosis, both anatomical and pathological, and draw a picture of his idea of that diagnosis before exploration, then by exploration the internist's diagnosis made from the symptoms is checked up by the findings. It has been very interesting and we have attempted to divide the evidence under four heads: (1) the history; (2) the laboratory findings; (3) the physical findings, and (4) the *x*-ray findings. I cannot tell definitely how many such cases we have worked out in this way, but a good many, and so far we have come to this conclusion: that so far as the diagnosis is concerned, the overwhelming evidence so far as value is concerned is in favor of the history. We come back time and time again after a mistake to find we have not interpreted the history correctly or elicited it properly. Without question, if one could estimate from our own experience the value of this evidence, that the history would represent two-thirds of the value in diagnosis, it would be borne out in these duodenal and stomach

cases. The history is everything in gall-stone lesions, almost everything in duodenal ulcer, more than anything else in pancreatic lesions. The next bit of evidence is the physical finding, third the laboratory findings, and fourth the *x*-ray. Sometimes the *x*-ray evidence is definite and positive, sometimes simply suggestive. Usually the positive *x*-ray findings occur in cases in which the diagnosis is easily made by other means, the physical findings of a tumor, the history of the case, all pointing to a definite carcinoma with palpable tumor. I believe the *x*-ray findings of value, but I am very much impressed with the fact that there is a widespread feeling that it is of enormous value in duodenal and gastric ulcer; it is of very little value in duodenal ulcer; in not one case out of ten is it of value. It is of very distinct value where there is a change in the anatomical conditions of the pylorus, or in conditions of hour-glass stomach and perforating ulcer. If you have a case come to you with either the patient or family physician stating that the *x*-ray shows a duodenal ulcer upon which operation is desired, let it mean nothing to you; we should be very careful about accepting a diagnosis of that kind.

One word in conclusion so far as the *x*-ray evidence is concerned. We are in a difficult position. I believe the surgeon should interpret the *x*-ray findings. I do not believe any mechanic or radiologist, unless intimately associated with a team of internist and surgeon, will ever become as well able to interpret the *x*-ray as the medical man himself.

Dr. John H. Gibbon, Philadelphia.

With regard to diagnosis I want to say a word. Taking the four methods of diagnosing these conditions, I believe with Dr. Bevan, first in the value of the history, but second in the value of the *x*-ray. With improvement in *x*-ray work, especially the fluoroscope, I think we have one of the best means of differentiating these conditions and diagnosing them far more accurately than we could have expected a few years ago. Therefore I would place the *x*-ray second and not fourth.

A word about the results of gastro-enterostomy. I have not had a perfectly clear conscience in what I have done in the cases of pyloric and duodenal ulcer which have come to me because I have not done pylorectomy often for these conditions. Dr. Rodman referred to the unsatisfactory results from gastro-enterostomy. I am convinced that the large percentage of failures that are reported annually by a number of operators is due to the fact that this operation has been done and is done today in numerous cases where no ulcer is found.

A gastro-enterostomy done without a demonstrable lesion of course is not going to cure the patient. I think this helps to cancel a certain proportion of the unsatisfactory results from simple gastro-enterostomy. I believe the results are better since attempts are made to obstruct the pylorus where the ulcer itself is not going to result in obstruction. In order to get at the comparative value of gastro-enterostomy and pylorectomy we have to take the number of cases of gastric ulcer which after gastro-enterostomy have developed cancer. Then take the difference in the mortality between gastro-enterostomy and pylorectomy and see whether the percentage developing cancer is greater than the difference in the mortality between these two operations. If the percentage of cases developing cancer after gastro-enterostomy for simple ulcer is 5 per cent., and if the mortality from pylorectomy is 10 per cent., and from simple gastro-enterostomy 3 per cent., I would say gastro-enterostomy was the right treatment. My own conviction is that the difference in mortality is much higher than the percentage of cases developing cancer after gastro-enterostomy. I want it understood that I am speaking of ulcer cases, not the doubtful cases, not the cases we know to be carcinomatous, and not the cases where the ulcer is situated in the body of the stomach and easily excised.

Dr. John Bapst Blake, Boston.

With regard to the question of excision of the pylorus, I would call attention to the fact that it was early shown what happened to food put into the stomach where gastro-enterostomy without obstruction of the pylorus was practised. That food did not, as a rule, go through the new stoma, but through the old opening, if the pylorus was not obstructed. All sorts of efforts were made to obstruct the pylorus; incidentally Sir Astley Cooper shows it to be almost impossible to permanently obstruct it. The only effective way is to cut it off, and if you cut it off and sew it over you might just as well excise it as Dr. Rodman says. You can by so doing get rid of your ulcer-bearing area and most effectually close the pylorus.

Dr. Howard Lilienthal, New York.

We have heard the expression "easy cases" today, but it appears to me that if an operation of this kind is good in an easy case it is still more important that it should be done in a so-called hard case.

In the matter of *x*-rays, I feel pretty well convinced that in roentgenology we have a powerful aid in diagnosis and that the future of the method is assured. While I would not venture to interpret

a plate against the opinion of an experienced radiologist, it appears important to me that the surgeon should see the plate or perform fluoroscopy as a matter of consultation with the radiologist.

Dr. George W. Crile, Cleveland.

I rise to support Dr. Rodman's views as to the excision of the ulcer-bearing area of the stomach, and I do so because in my own cases I have seen all these things happen which Dr. Rodman has mentioned. In cases which have had good postoperative care I have seen returning hemorrhage and perforation. After gastro-enterostomy I have seen ulcer and carcinoma developing upon the ulcer. Upon these grounds, in addition to the fact that in a certain number of ulcer cases the patient is not clinically well, I feel Dr. Rodman's position is correct. The ulcer-bearing area ought, if possible, to be removed. I think Dr. Gibbon put the question well in saying it really depended on the mortality rate of the operation of excision of the pylorus.

I am dissatisfied with our present mortality rate in resection of the stomach, and I do not think we have by any means reached the limit of surgical possibilities in reducing it. I believe we can reduce the mortality rate still further and make the resection operation sufficiently safe to bring it within the limitations of Dr. Rodman's description.

Dr. William J. Mayo, Rochester, Minnesota.

I want to agree again with Dr. Rodman in what I have already expressed in my recent letter to him.

I would like to come to the rescue of the radiogram. We found formerly in trying to solve the question of early cancer that in a large series of cases the clinical history was first, and then, second, came the question of obstruction. (I am speaking only of the cases we were able to resect.) Third was the presence of the tumor, and fourth the results of gastric analysis. The first now is the radiogram because in one hundred consecutive cases in which the radiologist did not know anything about the history of the case he has been able to make a diagnosis of cancer definitely in about 87 per cent., while the best we have been able to do by history or any other means (I am speaking of early cases) was formerly a bit over 60 per cent. So I think we can put the radiogram first in early diagnosis of cancer of the stomach.

So far as ulcer is concerned, I believe that in ulcer of the stomach, taking all cases, the radiogram would again be first. Perhaps the

history may be put ahead of the radiogram. In ulcer of the duodenum, unless there be obstruction, the radiogram does not equal the history in value, but it is a close second. I like to look at the plates myself, but for reading a hard plate, give me the opinion of the man who is used to it.

Backing up Dr. Bevan, the most illuminating plan is to get the whole crowd into the operating-room day by day, show the plates, open up the patient, and then show the radiologist his mistakes. In a little while you will be surprised how modest he will become and how much he will learn that will help him in the next case.

Dr. George E. Brewer, New York (in closing).

I am glad this subject has been so thoroughly discussed. All I can say is that it is still in an experimental stage. You all remember when we first began to *x*-ray stone in the kidney and ureter and how many mistakes we made. Then as the technique improved, including the use of the compression apparatus and the clearing out of the bowels, the percentage went from its former point of 10 to 20 per cent. of accurate results up to from 80 to 100 per cent. I do not believe there is a surgeon present who would not take an *x*-ray diagnosis of ureteral or urethral calculus in preference to history and chemical examination. The same is true in cases of fracture. Are we approaching the same accuracy in the stomach? By a rather new plan we are developing a method of serial radiography in order to follow a peristaltic wave right through from beginning to end, to see where it becomes abnormal, and I believe this method will give increasingly accurate results. There are opportunities for tremendous improvement in gastric diagnosis. In fact, we often have a clear clinical history, that strongly suggests gastric or duodenal ulcer, and exploration shows nothing; here we hope our method will prove of great value, because the negative results of our *x*-ray examinations have been always confirmed by operation.

In regard to many of our cases in the past, I have gone on the history, physical examination, and clinical findings, but we have often been mistaken. As Lockwood said a year ago, there is no sign or symptom or symptom-complex pathognomonic of ulcer. As Moynihan said recently, more than 50 per cent. of gastric ulcer cases have their origin in the right iliac fossa. If the *x*-ray will help to differentiate these cases, and thereby avoid the necessity of an exploratory operation, it will be of the greatest value. I think we are approaching it. I therefore simply give the result of our experience in 27 cases immediately followed by operation.

Dr. William L. Rodman, Philadelphia (in closing).

In the first place I would like to say what I would have said had I been able to read all of my paper. Ulcers in the expanded four-fifths of the stomach are not very liable to undergo cancerous changes. They should be subjected to partial gastrectomy, as the mortality is, however, less than 2 per cent. These ulcers are likely to bleed and perforate on account of the greater mobility of the stomach during respiration, and that protective adhesions do not form except in those situated on the lesser curvature of the stomach. I was very interested in Dr. Lilienthal's and Dr. Crile's remarks about the two-stage operation. It has been made very clear to me, in reviewing the statistics of a large number of cases reported to me, that a great many injudicious pylorectomies had been done in patients with perforation or who had bled severely. It would have been best to have done gastro-enterostomy first and subsequently removed the pylorus, even in bad risks. In that way I feel that the mortality of pylorectomy for ulcer can be brought down to approximately 5 per cent. Patients often object to the two-stage method because they have unpleasant memories of ether, but if one can follow the plan of anesthesia carried out by Dr. Crile he will find the patients have few unpleasant memories abiding with them.

It is possible that our best results in the future in operations on the prostate, in cancer of the stomach, cancer of the intestine, etc., will be secured by the use of the two-stage operation.

SUGGESTIONS REGARDING THE ANATOMY OF AND THE SURGICAL TECHNIC IN THE TREATMENT OF JONNESCO'S MEMBRANE

By JOHN E. SUMMERS, M.D.
OMAHA, NEBRASKA

In a paper which I read before the Surgical Section of the American Medical Association at its last meeting in Minneapolis, entitled "Surgical Aspects of Intestinal Stasis, from an Anatomic Point of View," I asked discussion upon the following points:

1. If the Jonnesco-Jackson-Reid membranes are congenital, are they always more or less clearly demonstrable in every individual, should the incision admit?

2. Are the membranes purposive? If so, are they not intended by nature as ligamentary supports—preventive of intestinal stasis rather than causative?

3. Therefore they should be divided only after they have become restrictive of intestinal function, from loss of nervous and muscular tone resulting from chronic intestinal toxemia.

4. Is the method of demonstrating the so-called "white line" always reliable? If so, does not this in itself prove the congenital origin of the membrane and its physiologic importance?

I believe that every thinking, informed man today should concede that all of these membranes are congenital; the demonstrations by Flint, Rilus Eastman, and others, clearly show this, and I have had so much personal corroborative evidence that these membranes can be demonstrated to a greater or less degree in every abdomen when the incision admits of a thorough

inspection, that I am no longer in doubt as to this, to me, established fact, and many of my friends are agreeing with me—some of them men of the widest experience in abdominal surgery. As Sir Arbuthnot Lane in one of his papers writes, "acquired mesenteries and adhesions," as he is pleased to call them, "were absolutely and categorically denied by physicians experienced in postmortem work, who appeared to think that, because they had escaped their observation as many things have done and will continue to do, they were justified in denying their existence in the most dogmatic manner possible." Many of these friends of mine who now agree with me as to the position that I take in this matter, formerly smiled, if they did not disagree. Now that they are looking for themselves they see with the same eyes that I do. The study of anatomy at the operating table has impressed me more and more, that the viscera of men differ as do their faces—there are no two exactly alike.

If the Jonnesco-Jackson-Reid, membranes are congenital and always more or less clearly demonstrable, then they *must* be purposive and intended by nature as an aid in carrying out the function of the bowel, and it is only when the arrangement of these membranes is at variance with the conduct of the normal function of the bowel, that the membrane becomes pathological, and this arrangement may be defective or restrictive—defective when the bowel is not properly supported, restrictive when its function is restrained or inhibited. Neither of these conditions is apt to be observed in childhood. The muscular tone is so positive in childhood and youth that the peristaltic action of the intestine overcomes minor difficulties. It is only when this tone, from physical conformation of the skeleton, habit, or long continued over-strain, becomes lessened, that a too loosely supported bowel or a too tightly restricted bowel is unable to functionate without the development of more or less intestinal stasis with its accompanying symptoms. As Mr. Gray puts it,[1] it is the *manner* of attachment

[1] British Medical Journal, January 24, 1914.

of the membranous bands to the bowel or its mesentery that causes stasis. I have seen the so-called Jackson-Jonnesco membrane in a considerable number of individuals under twenty years of age, but have never seen symptoms produced in any one under seventeen years of age. Van Buren Knott tells of two infants under one year of age, with most extensive Jackson membranes, upon whom he successfully operated for intussusception, the Jackson membranes having nothing to do with the cause of the intussusception, and the infants being in good health succeeding the operations, with normal bowel function. Most of the cases that I have observed where abdominal symptoms were dependent upon *defective* or excessive development of the bowel in a so-called Jackson membrane, were in people over thirty years of age, and in several they have been between fifty and sixty years of age. The intestinal wall loses its tone just as the bladder may lose its tone from various causes. Therefore, two lines of procedure may be required for the relief of intestinal stasis and the accompanying symptoms—the *one* to release the bowel so as to permit of freer function, the *other* to support the bowel, thereby increasing its muscular tone. In excessive angulations from membranous restrictions it may be advisable to relieve the resulting stasis by an exclusion of the colon. I am not as yet prepared to admit the justifiability of its excision. Even without angulating bands involving the cecum and lower ileum, stasis in the ileum may be demonstrated as caused by an incompetency of the ileocolic valve. J. T. Case[1] has found by *x*-ray observation 250 cases of this kind in an examination of 1500 people in whom the competency of the valve was tested by the bismuth enema, and Kellogg[2] has reported a number of patients successfully operated upon for stasis of the lower ileum, the result of damming back from the colon because of incompetence of the ileocolic valve. So it is again seen that congenital membranes and bands of the right iliac fossa may in themselves be innocent of mechanically

[1] Medical Record, March 7, 1914.

[2] Surgery, Gynecology, and Obstetrics, November, 1913.

causing auto-intoxication. As Kellogg says, "the remarkable advances made in the technic of the *x*-ray study of the alimentary tract within the last few years, have rendered invaluable service in making it possible to locate the cause of obstruction in these obstinate cases." Further experience has convinced me that the so-called "white line," which I believe to be the line of fusion of the duodenal and colonic peritoneum with the parietal peritoneum after rotation of the duodenum and colon has been completed, is always demonstrable whenever the pericolic membrane can be shown, and it is the line of attachment of the pericolic membrane to the parietal peritoneum. It is demonstrated by rotating the attached hollow viscus in a direction continuous with the course of the bloodvessels and fibers of the membrane. I have called this "white line" the *ligamentary attachment* of the pericolic membrane to the parietal peritoneum. Usually, when it may be deemed best to release the intestine from the investment of this ligamentary support—the pericolic membrane—it should be divided along its loosest line of attachment; however, greater motility may be obtained in some instances by dividing the membrane at its base—the "white line;" when this line is short, as it frequently is in the hepatic region, the raw space, left by the division of the line in the direction with its course, can be closed by suturing at a right angle to the line of division. If the "white line" is a long one, as it sometimes is in an extensive membrane enveloping the ascending colon, this is not practicable. When, in addition to the presence of a Jackson membrane, there is a marked ptosis of the hollow viscera, particularly the cecum and transverse colon, the membrane should not be divided, but some of the methods advocated by Coffey and Connell are indicated. I have found, however, in women, that a properly fitted, front-lace, straight front corset, will relieve many of the symptoms that depend upon these ptoses, provided proper habits of life are observed. I deem it would be an unprofitable expenditure of time to discuss in detail the operations advocated by Lane and others, as you are quite as familiar with them as am I.

THE ILEOCOLIC VALVE AS A FACTOR IN CHRONIC INTESTINAL STASIS: OPERATIVE TREATMENT

By EDWARD MARTIN, M.D.
PHILADELPHIA

WHERE the ileum enters the cecum, the two lips which project into the lumen of the latter from its inner side, the upper being the more prominent and often forming a distinct shelf, are the conspicuous features of the mucous surface; nor can there be doubt but that, from the mechanical arrangement, the intestinal contents under usual conditions are allowed to pass in but one direction.

In an inaugural dissertation, presented in 1739 by Johan Nathanael Lieberkuhn, entitled, "The Colonic Valve and the Function of the Appendix," there is found a philosophical discussion as to the formation of an ideal gate, opening in but one direction at the ileocecal junction. Thereafter follows an excellent anatomical description as to how this ideal is realized in the human, and a word of praise to a Creator who so wisely constructed it in accordance with physiological requirement. There is a further reference to the fact that accurate descriptions of the valve had long since been given by Tulpius and Bauhin, and a tentative assertion to the effect that the structure and function of this opening were well known to those who are quaintly called "antiquoribus."

The nearly transverse shelf-like upper lip, at times feeling like a thin cartilage, projects a wing or retinaculum to either side, the posterior the better marked, the tips of which reach to the posterolateral and anterior teniæ respectively, and apparently receive muscle fibers from them. The lower lip also

projects into the lumen of the cecum, but to a less degree. Between these lips there is a transverse fissure; at times a deep recess, at times a more or less patulous opening the long diameter of which is vertical, this particularly when the lumen of a chronically inflamed appendix lies near the ileocecal juncture. Below this opening the cecum balloons out and is markedly flexed inward, exhibiting, as a rule, thin walls with the longitudinal bands, particularly the lateral ones, merging into the circular fibers. The ileum is inserted into the cecum at its point of inward flexion on the colon.

The picture presented by a cross-section of the ileocecal junction suggests that the ileum has been cut obliquely, its open lumen compressed from above downward and invaginated into the cecal wall, carrying with it all the coats of the latter except the peritoneum; its axis forming an acute angle with that of both the cecum and the ascending colon. The highly vascular lips of this opening exhibit both circular and longitudinal fibers, the latter lying between the former, as would result from an invagination. The circular fibers are, at times, but not invariably, strongly reinforced at the point of junction of the musculatures of the large and the small intestine, and exhibit constantly a distinct thickening at the extreme end of the valve. Moreover, these circular fibers, particularly those which form the thickening at the projecting lip margins, are completely circumferential. On external examination, when the usual subperitoneal fat is dissected away, there is often seen a distinct constriction at the point of ileocecal junction and at times a bulbous enlargement of the ileum, involving mainly its upper wall, proximal to this. Just behind the ileocecal junction passes the posterior tenia, fibers from which can be seen running to the ileum. Though the typical valve opening appears as a transverse slit with prominent upper lip and broad retinacula, there are frequent departures from this type, some of which are shown.

At the level of the upper lip of the ileocecal opening and its retinacular extensions the thin, sacculated cecum rapidly merges

into the muscular ascending colon. Keith, on the basis of this transition and as the result of extensive studies in the comparative anatomy of the region, recognizes as the cecal colon that part of the gut in the human which is regarded as the beginning of the ascending colon, representing the primitive cecum of lower vertebrates; as the cecum that part lying below the ileocecal opening. The thick musculature of the cecal colon Keith regards as a functional sphincter, since it is found in all mammals with well-developed cecums. Nor, according to him, in the living, can gas be pressed from the cecum in any direction.

This brief outline of anatomy would suggest that the ileocecal opening is peculiarly competent against regurgitation, because of both its conformation and its rich endowment with closing muscles. It also seems clear that the cecum is a sac in which there is delay in the onward passage of intestinal contents, that its propulsive powers are poor, that the forceful drive observed in the massive movements of colonic contents probably receives its impetus from the cecal colon stimulated to contraction by distention incident to a less powerful but probably rapid contraction of the cecum; and that the colonic sphincter of Keith aided by the retinacula and upper lip of the ileocecal valve serves as a means of protecting the cecum against the distending force of a column of semiliquid material partially or completely filling the ascending colon.

Rectal bismuth injections, while failing to demonstrate the presence of a cecocolic valve competent against reversed current, abundantly prove that the ileocecal valve is so, though its resistance may usually be overcome by either long-continued or forceful pressure. If it be granted that there is a true sphincter of the ileocecal juncture, and the weight of evidence strongly favors this, that this sphincter functionates as do other sphincters concerning which we have more definite knowledge, the pyloric cardiac or vesical, for instance, there must be a neuromuscular mechanism by virtue of which the closing muscle is in a condition of tonic contraction, with periods of opening or dilatation excited either by local stimulus, as from the push of

ileal contents against it, or reflexly as from the ingestion of food into the stomach. That the flow into the cecum may be forceful is suggested by the strong musculature of the lower ileal segment, by auscultation during meal times, and by fluoroscopic examinations; that the resultant rapid dilatation of the cecum is stimulating to peristalsis has apparently been proved by experimental and clinical observation. Hertz has shown that, by virtue of what he calls a gastro-iliac reflex, the filling of the cecum is due to an active peristalsis in the end of the ileum and relaxation of the ileocecal sphincter whenever food enters the stomach; that bismuth-containing chyme reaches the ileum an hour or even longer, before any appreciable quantity passes into the cecum; that the ileum is often full more than five hours after the last traces have left the stomach; and consequently that an accumulation of chyme occurs in the last few inches of the ileum where it remains and undergoes digestion actually longer than it does in the stomach. Hertz speaks of a gastrocolic reflex by virtue of which, on taking food into the stomach, there are forceful peristaltic movements driving the colonic contents rapidly onward, and which, if the pelvic colon be already full, lead to the desire for defecation; a rapid distention of the cecum incident to the increased quantity and force of ileal discharge into it would seem a simpler explanation of this well-demonstrated phenomenon. Hertz further notes that normal iliac stasis is increased in all conditions leading to spasm or to the inhibition of the normal relaxation of the ileocecal sphincter, as for instance in peritonitis due to acute appendicitis, when sounds normally indicating the squirting of the ileum contents into the gas-containing cecum cease completely, owing probably to spasm of the sphincter.

Lane reports a case, the cecum being fixed in the iliac fossa by acquired adhesions, in which bismuth remained in the terminal coil of the ileum for eighty-five hours. At operation no evidence could be found of mechanical interference with the effluent. This, which he calls the simple static form of obstruction cannot be identified by inspection or palpation; its recogni-

tion is based on careful bismuth and *x*-ray studies and the exclusion or absence of other adequate cause.

Hypertonicity or spasm of sphincters, with slowing or stoppage of the current through them, is common; relaxation or paralysis, with rapid continuous current or a reversal of this, is rare. Thus cardiospasm is noted in many hospital reports, while rumination is almost a medical curiosity. Pylorospasm is a fairly constant complication of gastric ulcer, gall-stones and chronic appendicitis, pyloric incompetence is rare; vesical sphincterismus is a frequent and annoying sequel of pelvic and abdominal operations; when clinical incompetence develops it is usually a terminal stage of this sphincteric hypertonicity and indicates an overfull bladder with sufficient intravesical tension to master the sphincteric resistance.

Against incompetence, and particularly against regurgitation, the ileocecal opening has been especially well guarded. That such back flow may occur as a result of high tension in the cecum incident to rapidly developing colonic obstruction, or to its wide dilatation, or to cicatricial distortion of the lips of the valve, is possible. That is occurs in the absence of such factors, or even habitually in their presence, is doubtful. Moreover, the operation designed by Kellogg, though it might produce a mechanical stenosis, could have no effect upon the valve itself. Hypertonicity or spasm of the ileocecal valve should, as contrasted with incompetence, be fairly common. From our general knowledge of sphincters we should expect it to develop, as an accompaniment of adjacent inflammation, either acute or chronic; the appendix, the overlying peritoneum. If the gastro-iliac reflex be recognized, certain affections of the stomach, whether due to local lesion, as ulcer, or secondary to lesion elsewhere, as gall-stone, should be causative factors. When no definite cause can be found, sounding terms are used, such as altered metabolism, vasomotor instability, and disturbed function of the ductless glands.

Incident to ileocecal valvular obstruction there is ultimately cecal dilatation, either because the cecum and colon are also

subject to a perverted reflex or because the slow delivery of the contents of the ileum fails to provide that stimulus to contraction and peristalsis that results from a rapid distention.

It is not difficult to formulate the symptoms which should indicate an ileocolic hypertonicity. Right iliac pain, irregular in onset and duration; made worse by fatigue but not necessarily by exercise, unrelieved by lying down, harassing rather than crippling, with periods of marked betterment, for each of which a different cause is assigned. Constipation, obstinate unless laxatives or purgatives be given, at times yielding best to those containing small doses of belladonna. Right iliac tenderness on deep pressure and muscular rigidity, suggested rather than demonstrated, except to the muscular and determined surgeon who centres on this region. Ultimately some or many of the symptoms which Lane has formulated under the term of intestinal toxemia. The bismuth *x*-ray findings indicate cecal and iliac stasis.

From such symptoms many patients suffer; few come to the surgeon, since they are not crippled and the problem seems to the medical man one of diet, hygiene, and perhaps medication; which it often is. Occasionally because of the persistence of symptoms, and particularly the location of pain and a vague history of a former acute appendicitis, the surgeon is consulted. Some of these patients are strong young girls; most of them, perhaps, are women at or near the menopause. Some have spent years under hygienic, dietetic, electromechano-hydrotherapeutic, psychopathic and osteopathic treatment, with indifferent results.

With some hesitation the surgeon makes the diagnosis of chronic appendicitis. On operation there is removed an appendix which may or may not show signs of a long-standing inflammation, but concerning which the pathologist reports in comforting terms. Search is made for a Lane kink (if the cecum be drawn well out of the belly a spurious one readily may be produced); for a Jackson membrane, or parietocolic peritoneal fold, usually without harmful effect; for a mobile cecum, found

in most women whose abdomens are opened or who are *x*-rayed for any cause; for lesions of the gall-bladder and pyloric end of the stomach. The appendectomy is at times curative, at times is followed by a psychic betterment which lasts but a few weeks. The symptoms recur in their preoperative form.

Under such circumstances, other causes of intestinal stasis having been excluded, the continuance of symptoms, particularly when the *x*-ray shows delay in the lower ileal segment, with or without an accompanying delay in the cecum, reasonably can be ascribed to hypertonicity or spasm of the ileocecal valve. This seat of obstruction may be removed from the body, as is done in colonic resection; or may be switched from the intestinal current by section of the ileum above it, and implantation of the proximal end into some part of the colon, usually the sigmoid. Such an operation has been widely practised and little reported. In Mr. Lane's hands, however, it has given admirable results when provision has been made against cecal and colonic dilatation incident to a reversed current from the new stoma. That such dilatation occurs suggests the dependence of adequate cecal evacuations upon stimuli derived from a normally functioning lower ileal segment and valve, and offers corroborative evidence to the effect that cecal retention may be a consequence and not a cause of blocking at the ileocecal orifice.

Since the stasis is due to hypertonicity of the ileocecal valve, the quickest, simplest, and safest way to relieve it would be by rendering this valve partially or completely incompetent. Theoretically it would be advisable to preserve the mechanical efficiency of the opening against back pressure by leaving the valve lips intact while cutting the muscles, nor is this difficult of accomplishment if the increment of fibers usually, but not always, found at the angle of junction of the iliac and colonic musculature be the true sphincter. A section across and through this angle half an inch long, carried down to the mucosa and sutured at right angles to the line of incision, breaks this muscular ring, and alters but little the relation of the valve

lips to each other. If, however, the true sphincter lie in the free borders of the lips of the opening, as suggested by practically all the sections, the valve, being exposed by a small cecal incision, may be stripped from within to its base, or a cut may be made passing through the entire thickness of the intestinal walls, including the valve, in a direction parallel to the long axis of the ileum. By uniting this wound at right angles to its course the caliber of the opening is increased proportionate to the length of the incision and neatness of subsequent suture, the sphincter is permanently destroyed, the valve lips are no longer efficient guards against back pressure. Such an operation was reported by W. J. Mayo, who in 1899 removed, without relieving symptoms, the appendix from a muscular young girl suffering from right iliac pain aggravated by purgatives, soreness in the cecal region, and some muscular rigidity. Her small bowel was full, and at its junction with the cecum was reduced one-third to two-thirds caliber by a string-like constriction. Six months later an operation, involving the ileocecal junction in the nature of the Heineke-Miculicz pyloroplasty, was done, the incision into the gut wall being two and one-half inches long. This was followed by great betterment in symptoms, as was true of another case operated upon the following year.

The conclusions which seem justified by this study are:

The ileocecal valve has a double mechanism; one mainly mechanical, so planned as to prevent regurgitation, but not entirely competent against long-continued or forceful back pressure; the other primarily designed to insure a physiological stasis of its contents in the lower segment of the ileum.

The muscular portion of the juncture is a true sphincter with the neuromuscular mechanism implied by the term. Its habitual condition is one of contraction. It opens by virtue of inhibitory impulses of direct or remote origin. Its functional derangement is expressed in the form of hypertonicity rather than the reverse.

A hypertonic ileocecal sphincter causes not only pathological stasis of small intestinal contents, but also cecal stagnation, dilatation, and sagging; which, though incident to the ileocecal

spasm may, in its later development, be a factor in its continuation and aggravation.

The constipation and accompanying ill-health of otherwise clinically quiescent cholecystitis, gastric ulcer and chronic obliterative appendicitis are best explained on the basis of ileocecal spasm. The prompt relief of both the constipation and its attendant symptoms, on removal of the underlying and in itself inadequate cause, gives further strength to this view.

The symptoms of ileocolic spasm are: (1) Constipation; inveterate, and requiring laxatives and purgatives for its relief, but not in colossal doses. Pain in the right iliac region, subject to causeless remissions and exacerbations; made worse by fatigue, uninfluenced by posture, at times absent. (2) One or many of the symptoms of intestinal toxemia, the earliest ones invariably being psychic, as shown by mental fatigue on trifling effort and an undue mental reaction to the usual routine or the unusual events of daily life.

Corroboration of the diagnosis is afforded by bismuth *x*-ray examination, perchance by auscultation during meals.

The object of treatment is to provide a normal or even an abnormal effluent. This is best accomplished by an ileocecal plastic which either cuts the sphincter and prevents it from uniting, or divides all the encircling fibers, including the valve lips, and greatly enlarges the opening.

It is probable that at times the beneficial effects of the colotomy or the sigmoidoscopy are incident to the elimination of the ileocecal valve as an obstructing factor.

DISCUSSION

Dr. George E. Armstrong, Montreal.

The question as to the function of the ileocecal valve is not altogether new. John Hunter had a large collection of ileocolic valves from a goodly number of vertebrates, but died before he had worked them out. Keith, of the Royal College in London, is inclined to regard it rather as a sphincter than as a valve, and some of the *x*-rays in the London Hospital have tended to show that normally there is a stasis at the lower end of the ileum, and the large number of lymphatic nodes situated in this region would seem another evidence that there is normally stasis with a more than usual amount of absorption. It has been shown in some *x*-rays that the taking of food into the stomach will stimulate the emptying of the ileum and the claustral movement in the large bowel following, but this does not seem to occur in all cases. I have had Dr. Pirrie examine a series of cases with the view of determining these points; and while as a rule there seems to be a moderate stasis at the lower end of the ileum just before it enters the cecum, it is not always true that the taking of food stimulates the emptying of the cecum. Another evidence of stasis that I have noticed in a small series of cases is a slow form of pyogenic infection of some of the lymphoid nodes about the lower end of the ileum and scar tissue having a decidedly narrowing effect altering the direction of the ileum and lessening its caliber. I think it is quite possible that the ileocecal valve may have a double action. That it may be designed to a certain extent to delay the emptying of the ileum and also have a valve action to prevent the back flow of the contents of the colon loaded with bacteria, where bacterial digestion goes on normally, from receding into the lower end of the ileum.

Dr. Jabez N. Jackson, Kansas City, Missouri.

The question of origin of this pericolic membrane and its development is one of great interest with many conflicting views and theories. I am frank to admit that even now, after some considerable observation, I am still in doubt as to its true etiology. I am somewhat inclined to the theory presented by Dr. Summers of a congenital origin, but I also believe there are other factors influencing its development as a clinical entity. Curiously some seem to infer that if or because it is of congenital origin, it is of no importance clinically or surgically. The tendons of the foot are all congenital, and club foot

may be congenital. Certainly no one would therefore argue that congenital club foot has no surgical importance. Congenital or not, the pericolic membrane which mechanically interferes with the mobility of the colon is as truly surgical as the contracted tendon which interferes with the mobility of the joint.

Concerning the correct surgical treatment, it is obvious that in the true case we have two factors of positive importance. (1) The restricted and angulated colon above the cecum, and particularly about the hepatic flexure; (2) the dilated, mobile, atonic cecum, which we believe is a sequence of result of the obstruction above. In our original surgical efforts we recognized the importance of the factor of obstruction alone and confined our efforts to removing the obstructing membrane. Later we realized that the atonic cecum added a positive element to the case, and we added to our surgical efforts the plication or fixation of the cecum as practiced by the German school. Our results have improved. We have not practised short-circuiting. It will require time and an honest analysis to arrive at absolute conclusions as to the correct surgical treatment.

Inasmuch as my name has been somewhat identified with this membrane about the right colon, I feel called upon at this time to correct some errors which have arisen concerning it. When I first had the honor of presenting my original article on "Membranous Pericolitis or the Pericolic Membrane" before the Western Surgical Society in 1908, many of my colleagues and friends were frankly skeptical and questioned in toto the existence of such a condition. Today, on the extreme contrary, we find some who declare that it is a normal anatomical development which is present in everyone. Each of these positions is erroneous. By traction on the colon delivered through an abdominal incision with exposure of the gut one can produce a venous engorgement of the peritoneum of the outer wall of the colon, which presents a picture somewhat resembling that of the pericolic membrane. But in this event there is no evidence of a true membrane, and there is no restriction, angulation or other mechanical factor interfering with the mobility of the gut. When the colon is dropped back into the abdomen, the vascular injection disappears and we have a normal colon. This is *not* a "Jackson Membrane," has *no* surgical or clinical significance and should be *left alone*. On the contrary, when a true pericolic membrane exists, it will be apparent to the eye as soon as the colon is exposed. It can be seen to bind the colon closely in the loin, and it is difficult to draw the gut to the abdominal incision. The angulation and restriction of the colon's mobility is obvious. The symptomatology is positive.

The extent of the development of the membrane may vary widely, but there must always be present evident mechanical abnormality. Otherwise it is in no sense the pathological or clinical entity which I have endeavored to describe. The true pericolic membrane is *not* common but it *is* an entity. There are too many pseudo cases being found and positive harm must follow ill-directed surgical meddling with such cases.

Dr. Edward Martin, Philadelphia (in closing).

There was no intent to convey in the impression in the paper just read that the ileocecal valve was either a personal or a recent discovery. Indeed, even the casual culler of the wisdom of the elds well realizes that this structure has been clearly recognized and described for centuries. It has been satisfactorily shown, at least as satisfactory as this is possible, by radiographic studies that the content of the alimentary tube is delayed longer in the lower ileum than even in the stomach. Nor is this delay explicable on any other basis than on that of the existence of an ileocolic valve. The distinct muscular sphincteric action—we are all familiar with the marked curative effect of the constipation by the removal of the appendix—which may show at the worst evidences of an old inflammation. Nor can this curative effect be explained by any other mechanism than that of the relief of the reflex sphincteric spasm.

BLEPHAROPLASTY BY A PRE-GRAFTED FLAP

By CHARLES GIBSON, M.D.
NEW YORK

In the late nineties, while acting as surgeon to the Work House and Almshouse Hospitals, I had several opportunities to see the end results of plastic operations performed for the relief of tissue defects resulting from excisions of epitheliomas of the eyelid. These were, in general terms, very bad, very unsightly, and very uncomfortable. The plastic flap in most of these cases was tightly stretched across the eye-ball and adherent to the conjunctiva, causing discomfort and distress and lamentable cosmetic appearances. It occurred to me then that in attempting to reconstruct the eyelid we ought to keep its functions in mind and try to reproduce them in any reconstruction work.

A proper eyelid is, of course, smooth, is lined with an epithelial layer, in this case representing the mucous membrane of the conjunctiva, and of course is free from the eye-ball. It seemed to me, therefore, that any transplanted flap which was to replace a gap in the eyelid should have an epithelial lining. The epithelial lining could, of course, be supplied by applying a skin graft to the back or raw surfaces of a pedunculated flap, and there is sufficient evidence that epidermis transplanted into mucous-lined cavities assumes to a sufficient degree the characteristics of the mucous membrane.

I found that quite naturally the same idea had occurred to others; that is, after plastic flaps had been made, to fill the gap in the eyelid, a skin graft was put on the reverse side.

Personally, I never had any opportunity to verify the results, good or bad, of this procedure, but I knew from general experience that skin grafting under these conditions gave no assurance of successful union. I determined, therefore, to devise a method which would allow the transplantation of a flap which already satisfied these conditions.

My first case, Lena W., presented herself ten years ago, and gave me the opportunity to carry out these theoretical requirements. In her case I deliberately chose to utilize the form of plastic advised by Driffenbach, which I believed would assure me the best kind of flap with which to carry out the preliminary grafting, although the flap itself, having a pedicle lying vertically below the eyelid, possessed the disagreeable feature of drawing down the eyelid and the result was not any too satisfactory on account of the inherent defects of the flap, although the requirements, namely, a movable eyelid with the internal surface lined by epithelium and non-adherent to the conjunctiva, were obtained. In my second case I chose to make the flap recommended by Fricke, but more nearly horizontal, and the result was so satisfactory that it is this operation that I describe and recommend.

We start out then with the idea that we shall outline the flap and prepare it by grafting its inner surface and only remove the lesion (epithelioma) and transplant the flap into the resulting cavity when the flap shall have been demonstrated to be properly prepared to take the place of the eyelid. A two-stage operation then becomes a necessity. The various steps of the operation are readily understood by a study of the accompanying illustrations. The preliminary operation might be done, if necessary, under local anesthesia, but I should prefer it to be done under a general anesthetic, as was done in both cases, so that the outlines of the flap should not be obscured by infiltration of cocaine or possibly the wound healing so jeopardized. The first step consists in making an incision through the whole thickness of the skin, starting at the external canthus and running somewhat obliquely upward for a suitable distance,

according to the size of the flap required. In my two cases the lesion occupied the external half of the lower lid and a flap one and three-quarters inches was outlined. Fig. 1 shows the

FIG. 1

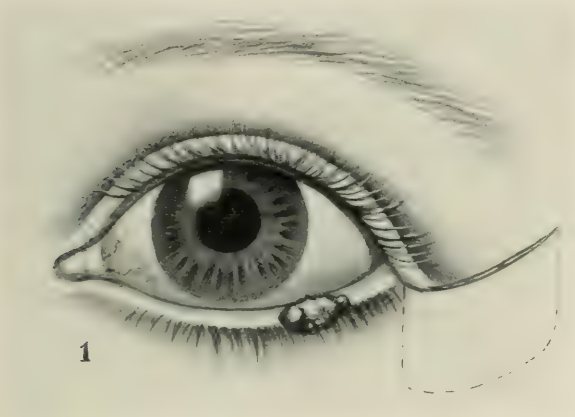
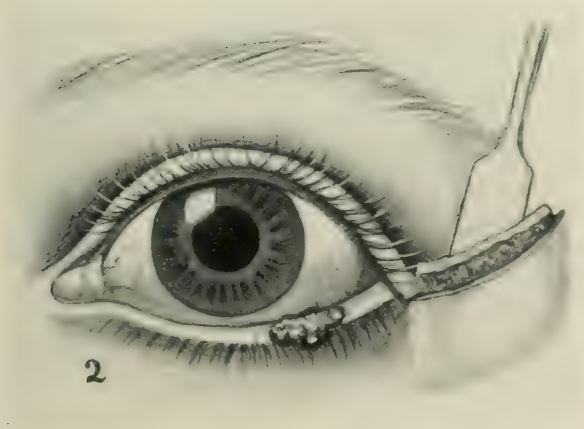


FIG. 2



single incision through the skin, the dotted lines show the area of the proposed flap. By dissecting down through the preliminary incision a pouch is made corresponding to the size of the eventual flap and into this the skin graft can be tucked

just as one places a handkerchief in the pocket. A single skin graft of suitable proportions is cut and is introduced into the

FIG. 3

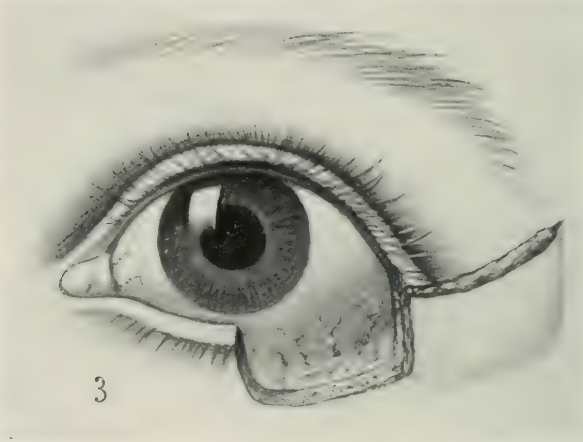
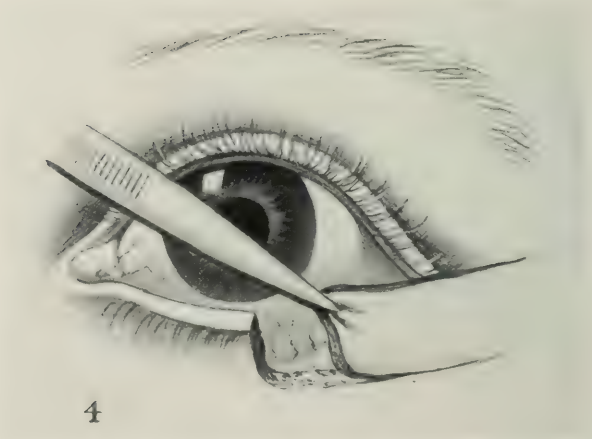


FIG. 4

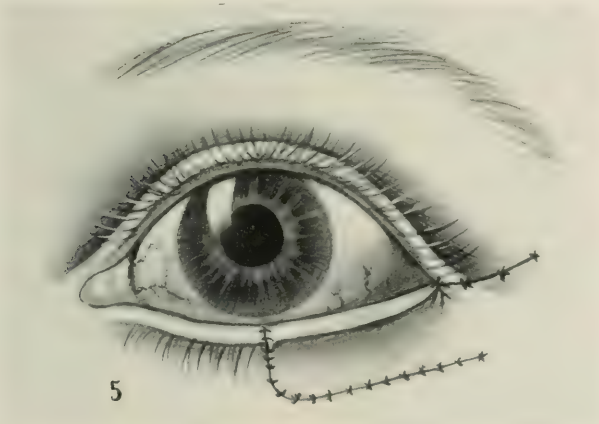


pouch, as shown in Fig. 2. It is a little larger in its vertical diameter than is necessary, allowing the top portion to be turned over on the raw edges of the flap. That completes the first

stage of the operation. A protective dressing is applied and the graft is allowed to heal in place and the transplantation is not made until the healing is an accomplished fact and no raw surface exists. That would ordinarily take about ten days.

At the second operation the epithelioma is excised by removing the outer half of the eyelid by a quadrangular incision, the outer vertical leg of which just impinges on the skin out of which the pre-grafted flap is composed (Fig. 3). In Fig. 4 is shown a horizontal incision parallel to the first original incision, thus freeing the flap and allowing it to be slid over into the

FIG. 5



gap left by the excision of the epithelioma. Fig. 5 shows the flap sutured into place and the operation completed. The healing takes place readily in less than a week. The after-results have been satisfactory, as can be seen by the photographs of these patients. While the result in patient one is not quite satisfactory it is because the poor type of flap was used, but even then the advantages of the pre-grafted flap are obvious in that there is a free palpebral margin lined with a perfectly satisfactory substitute for mucous membrane which it now closely resembles. The preliminary operation allows for the

occurrence of a normal shrinking of the flap and in making these flaps it is only necessary to cut them of the exact size necessary to fill the gap.

FIG. 6.—Case I. Ten years after operation.

FIG. 7

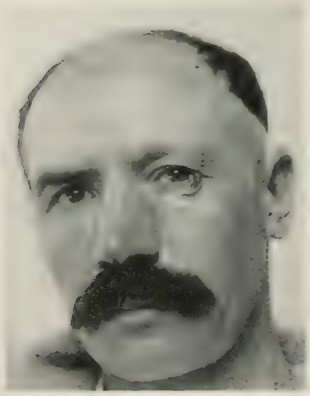


FIG. 7.—Case II. Before operation.

FIG. 8

FIG. 8.—Case II. Seven years after operation.

This is a fact that I learned by experience in these two cases where in each instance, following the general principles of plastic surgery, the flaps were made over-generous with the

expectation that they would subsequently shrink. This shrinkage did not occur and in both cases we have an over-generous palpebral opening. Ten years in Case 1 and seven years in Case 2 have elapsed since these operations, and in all that time the flaps have not shrunk or altered in any way.

Since the advent of various therapeutic measures destined to compete with surgical procedures in the removal of epitheliomas involving the eyelid, such plastic operations have perhaps enjoyed less popularity than formerly and, if one recollects the miserable results obtained by the former conventional methods, it is not surprising that there should be a temptation to utilize *x*-ray, radium, and other methods of less proved efficacy. It must be borne in mind that the patients here presented have not only satisfactory eyelids, but can be presented at the lapse of these years as cured of their epitheliomas, whereas at the present time no similar assurances can be given for the value of the competing methods.

DISCUSSION

Dr. Samuel J. Mixter, Boston.

The method proposed by Dr. Gibson, of course, has the great advantage that he spoke of, of giving a flap which will not adhere and will not roll in. It seems to me this can be applied not only to these small flaps but to large "jump" flaps transplanted from other parts of the body. In case of destruction of the whole eyelid, or both eyelids, or in the cicatricial contractions after burns where it is necessary to use a large flap, I have found that a flap transferred from the abdominal wall worked beautifully, carried by the wrist. In that way I have been able to correct large deformities in the face caused by burns, with practically the loss of both eyelids. This addition of grafting would add greatly to such a procedure.

THE CAUSAL RELATION OF TRAUMATISM TO TUBERCULOSIS

By JOHN CHALMERS DA COSTA, M.D.
PHILADELPHIA

The Courts of Philadelphia and, I doubt not, the Courts elsewhere, are at times obliged to consider the question of the relation of trauma to tuberculous lesions—pulmonary, glandular, osseous, and articular.

The law is often an organized and methodical bewilderment. Lawyers are professional bewilderers who are occasionally accurate and truthful and then not always from virtue, but sometimes perhaps from necessity or deep design. They raise a cloud of dust to obscure the facts and then vainly try to find a way out. The Judge may be a self-constituted oracle of surgical knowledge, an irritable repudiator of everything modern and reasonable, or he may sit in dignified isolation from all mundane annoyances and all irritating and contaminating truths. Medical witnesses are often partisan and controversial, are not very usually inaccurate and unreliable, and are sometimes actually mendacious. Some of them cheerfully swear to things they would not bet on. The elder Dumas said that it is the book which it is impossible to read which creates a sensation. The same may be said of dinners it is impossible to eat, and of testimony it is impossible to understand. In the average damage suit there is much contradictory testimony from medical experts. Some of the testimony may have as little meaning as the frozen words which fell upon the deck of Pantagruel's ship. The Judge and jury, even if instigated by the best intentions, may pass into the deepest

error, and so the wrong may triumph. Surely a more stupid method of seeking truth and hence of obtaining justice could scarcely be devised. Such views will not be popular with lawyers and professional medical experts, but in the words of Paul to the Gallatians, "Am I become the enemy because I speak the truth?"

In a Philadelphia case, in which it was claimed that the plaintiff suffered from traumatic tuberculosis of the lung, the learned judge, apparently indignant at the mere mention of such a thing, directed the jury "to exclude all evidence touching the question of traumatic tuberculosis as fully and conclusively as if none had been offered," maintaining that "the attribution of tuberculosis to trauma does not rise above the grade of a theory adopted by a small number (a most respectable number it is true) of one profession."[1] The judicial light above quoted calmly settled the whole question off-hand and without mental effort, and decreed that hereafter traumatic tuberculosis was to have no standing in court. Lawyers express surprise that medical experts ever disagree. Lawyers always disagree. There is at least one on each side of every case, the judge often disagrees with both of them, and the Supreme Court, which has the last guess (by a majority vote), often reverses the verdict of the lower court. In the case cited above the Superior Court of Pennsylvania disagreed with the trial judge and reversed the judgment, declaring that the testimony relating to traumatic tuberculosis "should have been submitted to the jury for its consideration."[2] The Court said: "There is a clear distinction between the guess and conjecture that is inveighed against by some judges and some text writers, and the carefully formed opinion of capable, honest and eminent physicians."[3] In the trial of the case one expert testified that a man has eleven ribs. As Mark Twain said of Fenimore Cooper—"he dealt freely in important omissions." Perhaps he was seeking to justify the narrative in Genesis which tells of the creation of Eve. In the second trial a new medical witness was discovered by the defendant. He swore that he had attended the plaintiff three years

before the accident and had a record of the case in his case book, and that long before the accident the claimant was the victim of pulmonary tuberculosis. In the first trial one expert swore that the relation between the injury as a cause and the existing condition of the patient was obvious, and unhesitatingly affirmed that the tuberculosis was caused by the injury. In the second trial some of his views had undergone a sort of benevolent assimilation from the outside. His revised statement was that nothing in the case, independent of the history, could lead him to regard the condition as "traumatic consumption." The judge in his charge attached great importance to the testimony of the witness who swore that he had attended the plaintiff long before the accident and had attended him for consumption, yet the jury brought in a large verdict for the plaintiff.

Such are some of the confusions relating to this subject. Such are some of the vagaries of judges, attorneys, expert witnesses, and jurors.

Because of the unsettled opinions and divergent views made evident by the case cited above it seems worth while to review and bring together what we do know about the alleged relationship between trauma and tuberculosis—to try to discriminate between known facts and wild guesses, between reasonable deductions and fanciful conjectures. The question is as follows: "Is an injury ever a determining cause of a tuberculous lesion?" We all know that tuberculosis may follow injury, but that one thing follows another thing is no proof that the first was the cause of the second. To prove that tuberculosis can result from an injury we must prove that injury has a tendency, under certain conditions, to determine lesions of tuberculosis.

Until 1882 the opinion was general that injury was causal of what they then called a scrofulous joint, a strumous joint, fungous arthritis, or white swelling.

Erichsen[4] expressed the general view. In speaking of "strumous" joints he says: "This condition has not in many cases any definite starting-point, but appears slowly to supervene upon some slight injury, as a twist, or blow, or strain;

at other times it commences with a subacute synovitis, assuming its peculiar characters by occurring in a strumous constitution and is especially liable to happen in children and females." Samuel D. Gross[5] was one of the very few to emphatically deny a local origin of tuberculous joints. He considered the exciting causes to be "very obscure, if not utterly inscrutable. The surgeon is often told that the patient, perhaps weeks or months before the appearance of the characteristic phenomena, received some injury, as a blow, fall, or kick, or that the affected joint had been sprained, bruised, or twisted, but such information is usually not trustworthy, or if such an occurrence did take place, it probably exerted little, if any, influence in developing the complaint." Gross named many conditions as predisposing causes, saying: "Whatever has a tendency to enfeeble the system or to derange the blood are so many predisposing causes of the disease, if they do not actually call it into activity." Among these alleged causes he mentioned typhoid fever, measles, smallpox, scarlatina, chronic diarrhea, protracted courses of mercury, copious and repeated hemorrhages, chronic digestive disorder, unwholesome food, poor assimilation, imperfect nutrition, and infantile cholera.

We know at this day that some of the conditions mentioned by Gross did not produce tuberculous joints, but did produce special forms of joint disease not then identified. This is true, for instance, of typhoid fever. The other conditions could favor the development of tubercles in the body by lowering general body resistance but could have no power in determining its location in bone, joint, or pulmonary tissue.

Max Schuller's[6] widely quoted experiments were made in 1880. They seemed to indicate the tuberculous nature and the frequent traumatic origin of "strumous synovitis." Schuller performed tracheotomy upon dogs and rabbits, injected tuberculous material through the tracheal openings and at the same time injured the right knee-joint of each animal. As a result some of the animals developed general tuberculosis and some a condition that appeared histologically to be tuberculosis of the

damaged joint. In no instance did a joint which had not been injured become tuberculous.

Gibney, in 1877,[7] asserted that traumatism was causal in forty-two per cent. of his cases of joint tuberculosis.

Koenig[8] maintained the causal influence of trauma in half of the cases of tuberculous joints.

Téissier[9] believed that an injury of the chest followed by hemoptysis might be responsible for the development of pulmonary consumption.

According to Oliver,[10] Perrond, in 1875, claimed that the frequency of phthisis among the boatmen of the Rhone was due to the men "leaning with their chest wall upon the pole of the rudder in steering their ships. It was thought that the repeated pressure favored the development of pulmonary lesions, the interesting point being that the maximum focus of the disease as revealed by ausculation always appeared to be located at the level of the point of pressure by the pole, viz., under the right clavicle."

In 1882 Koch discovered the tubercle bacillus and this discovery strengthened the belief of all who denied the influence of traumatism in the production of local tuberculosis. They said: "the disease can be caused by the bacillus alone. Traumatism cannot cause the bacillus. Hence injury is casual, never causal."

W. Müller,[11] experimenting on the bones of goats, injected tubercle bacilli into the nutritive arteries without inflicting trauma on the bones and tuberculous osteomyelitis developed. This seemed like experimental proof of what everyone knew that the condition could develop without trauma. Lannelongue and Achard[12] injected tubercle bacilli into guinea-pigs and in from nineteen to twenty-one days later produced bone injury and joint damage, yet tuberculous disease did not arise in the damaged areas. In these cases the injuries were inflicted at too late a period after injections.

Friedrich[13] actually asserted that joints subjected to traumatism were less likely to become tuberculous than uninjured

joints. Some corporations would be glad to pay money to have this view petrified into established law. It is worthy of note that Freidrich used attenuated cultures in his inoculations.

Frazer[14] by injecting bacilli into the nutritive arteries did not produce tuberculous osteomyelitis. Krause[15] injected guinea-pigs and rabbits with pure cultures of the bacilli. At the time of the injection, or very soon afterwards, he broke a bone and injured a joint. In no case did the seat of fracture become tuberculous. In one-third of the guinea-pigs and one-half of the rabbits the injured joint became tuberculous. In only one case did a joint which was not injured become tuberculous.

Salvia[16] injected rabbits with virulent cultures and claimed that injury localized tubercle. Animal experiments are inconclusive and contradictory.

Drs. H. A. Wilson and Randle C. Rosenberger[17] say, "it is impossible to accurately compare animal experiments with the process as seen in human beings, for the reason that the means of infection employed in animals essentially differs from the infection of children. Animal experiments are wholly artificial and necessarily so. Direct inoculation of a child's joint does not occur, nor is trauma of any kind ever applied in the manner resorted to in experimentation. The results of animal experimentation are therefore interesting, instructive, and illuminating, but too much reliance should not be placed upon them in determining a solution of the problem. Very little information is obtainable as to the kind of trauma that was employed in the experiments. It is impossible, therefore, to determine the relative value, as causative or contributory factors, of severe injuries, sprains, contusions, lacerations, bruises, indirect trauma and functional trauma."

At the present time some surgeons absolutely deny any relation between trauma and tuberculosis. Richard Stern[18] states that most surgeons, judging from clinical experience, deny that trauma is concerned in the development of osseous or articular tuberculosis and that if it appears to be, the bone or joint was previously tuberculous.

Nicholas Senn,[19] in 1892, affirmed with emphasis that trauma can only be an exciting cause of tuberculosis of bone in a person "already infected with the essential cause." He did not say that a person must have a lesion of tuberculosis. He states specifically that the *bacilli* must be present in the *tissue* or in the *blood* at the time of the injury.

Wilson and Rosenberger[17] emphatically deny that trauma has any "existence in the etiology or in the beginning of the process" in bone or joint tuberculosis.

Many surgeons still affirm a relationship. All admit that a local quiescent focus may be lighted up by an injury. Nobody believes that injury under any circumstances causes the bacillus. Nobody believes that injury without the bacillus is under any circumstances capable of causing those tissue changes which we call tuberculous. What many do believe is that injury may determine the development of tuberculosis in a part previously free from lesion. Among the many surgeons who believe that injury may determine the development of tuberculosis we may mention Bradford and Lovett, W. Watson Cheyne, Nicholas, Bryant, Sir Frederick Treves, Tillmann, Golthwaite, Voss, and H. L. Taylor. Many medical writers never speak of the matter at all. Jacoud of Paris,[20] in 1896, reported a case of phthisis which he believed to be due to traumatic pneumonia. Weir, of Glasgow,[21] reported a case of a man who was struck on the chest and developed pleurisy and finally phthisis. Some call this contusion tuberculosis.

Oliver[22] has seen cases which suggest "a causal connection between injury and tuberculous lung disease." Other observers have been convinced that tuberculous meningitis can follow a head injury (Waibel,[23] Erhnrooth[24]). Traumatic tuberculosis of the breast and traumatic tuberculosis of the kidney have been described.

The relationship between injury and tuberculosis has been a subject of considerable debate in Germany since the promulgation of the workmen's compensation law in 1884. The new state insurance act must bring it to the front in England.

In the United States a horde of eager damage suit lawyers and a number of reluctant corporations are wrangling the question into prominence. It behooves surgeons to study the matter, to think it over with care, and to reach definite conclusions.

In the ensuing discussion I shall consider particularly tuberculous bones and joints. Joint tuberculosis is the condition in which the relation between trauma and tuberculosis seems to be closest.

Tubercle bacilli are particularly prone to take lodgement in and produce disease of cancellous tissue. The period of greatest liability is during the first decade of life, particularly during the first five years, though during the first year the disease is rare. Considerably more than half of the cases occur before the twentieth year. Many cases occur in persons much beyond the twentieth year, middle-aged victims are not rarities, and even the senile are not immune. Sir James Paget saw a case in a man of ninety-one. In the first decade the condition is about equally common in males and females. After the first decade up to the age of sixty it is most common in males. After sixty the disease is equally common in both sexes. Hereditary predisposition is often noted in children. It is found in at least twenty-five per cent. of them. Inherited predisposition is far less commonly evident in adults. The prognosis in adults is decidedly worse than in children, suppuration is more apt to occur and sequestrum formation is a more usual consequence.

Howard Marsh says,[25] "Indeed recovery, when either the hip or the knee is attacked in patients between thirty and sixty-five, very rarely takes place." The prognosis is worse in males than in females. Death may be due to acute general tuberculosis, to tuberculosis of distant parts (lung, brain, genito-urinary organs, peritoneum), to exhaustion, or to lardaceous degeneration. Of W. Watson Cheyne's cases[26] only 44 per cent. died of tuberculous disease and only 10.8 per cent. suffered from phthisis or tuberculosis elsewhere.

In cases of bone and joint tuberculosis *demonstrable* tuberculosis of the lung is rare, in fact, the victims of supposedly pri-

mary tuberculous diseases of a bone or joint seldom develop active pulmonary tuberculosis.

Howard Marsh[25] says, "At the Alexander Hospital, where there are always between sixty and seventy children under treatment for hip disease, and where the subsequent history of the case is, so far as possible, traced out, phthisis is so rare that sometimes a year passes without the development of more than two or three examples of it."

If tuberculous lesions exist in the lungs they are usually in "a comparatively dormant or recessive stage, and in the vast majority of instances do not progress, but clear up and disappear under treatment—and *pari passu*—with the improvement of the bone and the joint." (Woods Hutchinson.[27])

Old foci, often latent or regressive, may exist in the lungs or in lymph glands. Cornet[28] tells us that out of 67 autopsies made by Orth in Göttingen, 37 showed foci in the lungs, 21 in glands, 12 cases were found free from any focus beyond the bone and joint.

Which joint is most commonly attacked? Most writers say the spine. During the 15 years, from 1885–1899, 7841 cases were treated at the Hospital for Ruptured and Crippled in New York City. Of these 3203 were instances of Pott's disease, 2230 of hip disease and the remaining 2408 cases comprised tuberculous disease of the other joints (quoted by Weeks[27]). The lower suffer much more frequently than the upper extremities. Age is certainly a factor in determining localization.

In early childhood hip disease is most common, but the knee runs it a close second. The shoulder is seldom attacked during the first decade. The hip seldom during the third decade and very seldom during the fourth decade.

W. Watson Cheyne[26] arranges the various bones and joints in the following order of frequency of occurrence, from youth upward: hip; knee; ankle and elbow; tarsus; fingers; spine; shoulder; wrist; ribs. In order of frequency of occurrence during the first decade we have—hip; knee; spine; elbow; ankle; tarsus; fingers; wrist.

Statistics show that a considerable and perhaps a very large percentage of all cases are preceded by injury and suggest that not a few cases in reality are directly determined by injury. Some surgeons have assigned injury as a cause in 53 per cent. of cases (C. F. Taylor, quoted by Wilson and Rosenberger[17]). Others have restricted the number of traumatic cases to 10 per cent. Whitman[29] combined the statistics of Koenig, Mikulicz, Burns and Hildebrand, and thus obtained 3398 cases, 513 of which were described as traumatic.

Ribera Y. Sans[30] finds a record of antecedent trauma in 45 per cent. of cases of tuberculosis of the larger joints. Koenig believed that distinct traumatism preceded the disease in 50 per cent. of cases. Voss[31] set the percentage at twenty.

Bosanquet[32] says: "I think we must put disease of the joints in a class by itself. There is a considerable mass of evidence, that in some way or other injury does lead to tubercular arthritis." All statistics indicate that slight injuries are more often blamed than severe injuries. It is not a dislocation of a joint which is thought to be causal, but a sprain of a joint or a contusion of a ligament. It is not a fracture of a bone but a bruise of the periosteum or a strain of an epiphysis. Treves[33] says: "Another feature in tuberculosis is the trifling feature of the irritant or lesion whereby the mischief may be in the first place localized."

Statistics show conclusively that recognized trauma often precedes the disease. That trauma often precedes the disease does not prove that it causes the disease. The sequence is not of necessity a consequence. In order to prove that it is a consequence we must prove from known facts and justifiable deductions that an injury has a definite tendency to determine the development of the disease in bone or in a joint.

All admit that a great number of cases arise without any record or sign of antecedent traumatism or preceding joint disease. This is thoroughly proved by such recorded cases as the following. A boy while in bed and under treatment for tuberculous disease of one hip developed the disease in the other hip.

A person in apparently robust health may develop the disease. Bonney[34] says: "I have had occasion to note in a rather surprising number of cases the so-called idiopathic development of tuberculous processes in bones and joints among adult robust farmers and others accustomed to physical activity in the open air."

All acknowledge that if there is an existing active focus of bone or joint tuberculosis an injury may aggravate the local condition and even disseminate the disease. An injury may prolong an illness, may convert a case tending to cure into a case tending to joint destruction or may convert a curable condition into a fatal malady.

The great importance all surgeons attach to rest in the treatment of tuberculous joints indicates the general conviction that even trivial traumatism may be detrimental or actually dangerous.

Forcible movement of a tuberculous joint is apt to be followed by articular destruction or the development of distant lesions. The patients who are not kept properly at rest are most apt to develop tuberculous meningitis or mixed infection of the joint.

All admit that a tuberculous lesion of a bone or joint may become latent and that such an arrest of the activity of a lesion is a long step on the road to cure. No one denies that an injury may light up into violent and perhaps destructive progress an area previously quiescent. Just this course of events is sometimes noted when a stiff joint containing latent foci of tuberculosis is subjected to forcible straightening. So far there has been no dispute. We have now reached the parting of the ways of opinion.

One school of surgical thought holds that osseous and articular tuberculous is never primary, but is always secondary, and that when it is discovered after an injury, the injury was not in any sense causal of the disease, but merely aggravated a part already actively tuberculous or excited latent areas contained in the part into activity. In other words, it teaches that such a part was tuberculous before the accident and that the injury simply

revealed an area of tuberculosis whose existence was previously unsuspected or made more active an area of disease.

The other school holds that, while in most instances the disease is secondary, in some it is certainly primary. It admits that in many cases the injury has merely aggravated a tuberculous lesion or awakened from dormancy a latent area, but claims that in some cases injury is the direct determining cause of the disease. In such cases the part was free from all tubercles before the accident but quickly developed them afterwards. In such cases tubercle bacilli but not tubercles were in the part at the time of the accident or were brought there soon after it in the body fluids, such bacilli coming from some distant and probably unrecognized area of disease or having entered into the lymph and blood directly after ingestion, inhalation or inoculation. How can an injury be responsible for determining the development of tuberculosis of bone or joint?

Various bacteria by various routes are ever entering into the body fluids. Unless the number introduced is inordinately great, the bacteria are peculiarly malignant, or the defensive apparatus of the body is impaired in efficiency, the bacteria do no harm and are soon killed. Some organisms and some spores may, of course, become latent (typhoid pneumoccocci, staphylococci, typhoid bacilli, spirochetes), but as a general rule bacteria are soon killed when the individual's health is good and when they reach no area of tissue damage.

Vital resistance may be lowered generally. A number of organisms might produce no effect on a healthy man yet produce disease in a person ill-nourished, weak, debilitated by alcohol, diabetes or Bright's disease, shaken by fear or depressed by shock.

Vital resistance may be lowered locally. This may be brought about by disease, as when bronchitis lowers pulmonary resistance—or by injury, as when a hematoma becomes the seat of suppuration. A local region of lowered or impaired resistance is called a *point of least resistance*.

Injury ruptures vessels. In a slight injury a few very small vessels are ruptured, trivial and transitory hyperemia arises,

and little or no stasis follows. Stasis occurs after more severe injuries, but even when stasis occurs the area of stasis is surrounded by a zone of hyperemia. If blood contains bacteria, then hyperemia, which is a condition in which more blood passes through the part, means that more bacteria are brought to the part and many of them pass out into the perivascular tissues through the ruptured vessels.

Bacteria which enter the damaged tissues linger and tend to remain. Bacteria while lingering may pass out through the damaged vessel walls into the perivascular tissues. Hence an injury causes bacteria which are in the blood to linger in the region of damage and causes many of them to leave the vessels and enter as prisoners into the tissues. When bacteria linger they are dangerous—when they enter the tissues they are menaces. Instead of being carried rapidly by the part, as would have been the case had there been no injury, they make a prolonged stay in the damaged area, and during the prolonged stay, which was invited by the traumatism, they have time to batter down cellular resistance by means of their bacterial poisons.

It is well known that bacteria, which when in a part but a brief time do no harm, produce disease if retained. Nancrede[35] says: "Wegner and Grawitz have shown that the same number of germs, which when introduced into the peritoneal cavity will cause no trouble, because quickly removed by absorption, will produce a septic peritonitis if sterilized water be added to the pure culture. This so increases the bulk that a longer time is requisite for absorption, and hence a longer time is provided for the toxic substances to act locally; moreover, the inflammation usually starts at the point of original trauma, *i.e.*, the hypodermic needle puncture, the locus minoris resistantiæ."

Many years ago Chauveau pointed out that if a vein were injected with putrid fluid and a testicle crushed, the gland became the seat of septic gangrene.

Kocher showed that if an animal is fed upon putrid meat disease of bone does not arise unless the part is subjected to traumatism. If a bone is injured osteomyelitis is very apt to occur.

Nancrede[35] says: "The proof of these statements has been demonstrated by introducing into the circulation large numbers of the pyogenic cocci causative of osteomyelitis, whence they quickly disappear by means such as have been already, or will be later, explained. Repeat the inoculation, however, and then contuse or fracture a bone and promptly the microbes will be located and osteomyelitis will develop."

Every surgeon is familiar with the fact that osteomyelitis without a wound frequently follows traumatism and does so when there was no antecedent purulent focus in the bone. He is accustomed to search for a distant focus from which the cocci might have come. Sometimes he finds no such atrium of infection, at other times he finds a pyogenic focus in the pleura, the lung, the ear, the mouth, the tonsil, the prostate or the skin.

Nancrede[35] says, "A carious tooth, the lesions inflicted on the gums by the tooth-brush or tooth-pick, burns, scalds and damages of the buccal mucous membrane caused by the teeth, lesions of the nasal passages, and recently healed wounds, may any of them be the entrance-point of microörganisms productive even of fatal pyemia."

The surgeon never doubts that the bone injury determined the origin of the osteomyelitis, not by causing the creation of pyogenic bacteria, but by creating a point of least resistance, where organisms which previously passed through linger or lodge. Because of the trauma organisms which would have proved futile for harm and would have gone to rapid destruction live, multiply and produce disease.

In 21 of Hahn's 41 cases of vertebral osteomyelitis there had been antecedent traumatism and in six of these cases Hahn regarded traumatism as certainly the cause.

Acute infectious arthritis of the hip is usually determined by injury. The colon bacillus does not harm the appendix unless that part is congested or obstructed, kinked, twisted or bruised. When resistance is thus lowered the colon bacillus causes appendicitis.

In typhoid the germs enter the blood and may remain there

for some time. They tend to lie latent perhaps for a very long time in bone-marrow and yet may never cause disease. Traumatism will be followed by typhoid osteomyelitis. Trauma during or after typhoid may be responsible for typhoid spine. Traumatism of a bone in a syphilitic is followed by periostitis due to spirochetes. That pyogenic cocci and various other microörganisms act in this way is not disputed. It is well known that empyema may follow contusion of the chest. Is it unfair to assert that tubercle bacilli act in exactly the same way? They are so widely distributed, are so frequently taken into the body and are so hard to kill it would seem odd if they did not.

In fact, tubercle bacilli *do* act in the same way. They may enter blood and lymph from an active focus of disease, from a passive focus of disease, or directly by inhalation, ingestion, or inoculation without inducing disease at the point of entrance and when no known focus of disease exists. Latent lesions are most common in the bronchial and mesenteric glands, they tend to cure but may be raised into activity by some bodily disease or some injury. Even when not so goaded they may from time to time give bacteria to the system. We can seldom know that a latent lesion exists. Such a lesion is probably tuberculosis advancing toward cure.

Ravenel, Orth and others have shown that tubercle bacilli may pass through the wall of a normal intestine without causing any tell-tale lesion at the point of passage and may produce tuberculosis in the mesenteric lymph glands or may remain latent in the nodes for a brief or for a considerable period of time. Bacilli may lie latent in glands even when the glands are not diseased. They are very tenacious of life. The fatty material or wax of the bacilli "has the faculty of resisting, in a special manner, the influence of the digestive juices, of the phagocytes, the cells which exterminate dangerous microbes, and are therefore defenders of the animal organism."[27]

Living bacilli have been found in the feces of apparently healthy subjects. "It would seem rational to believe that the

feces, at least, would contain occasional tubercle bacilli carried into the mouth with the food or air, and thence into the digestive tract without infecting the patient." (Wilson and Rosenberger[27]). Rosenberger has knowledge "of at least two cases in which we have found bacilli in the feces, and in which, at autopsy, no macroscopical lesions of tuberculosis could be detected throughout the body. This does not mean, of course, that the patient may not have had an actual infection by tubercle bacilli at the time of examination of the feces and the discovery of the bacilli."[27]

Various observers tell us that at ordinary temperatures the bacilli will live and remain virulent in water for several months (Rosenau[27]). They will live much longer and freely travel in blood and lymph and may never induce tuberculous lesions.

That they can live in blood has been proved. They can enter the blood from the food by way of the lymph taken up from the intestines. They may enter the lymph from inoculation and perhaps from inhalation, and from the lymph they enter the blood. They may enter the blood from an active or latent focus of disease. If soup containing tubercle bacilli is given to animals the bacteria reach the blood of the heart within five hours (Besanti and Panisset).

In what Landouzy[27] called typhobacillosis, the blood contains tubercle bacilli in numbers. They produce a septicemic condition with positive symptoms, yet there may be no tuberculous lesion. If blood drawn from the vein of such a patient be injected into a guinea-pig the animal will develop tuberculosis.

The blood, even in a person devoid of any tuberculous lesion, must at times contain tubercle bacilli, which may linger long before dying, which may get into a gland or some other structure, there to remain latent or to induce disease. Tubercle bacilli have an affinity for special parts and tend to settle out into them (cancellous tissue of bone, lung, kidney and serous membranes). An injury tends strongly to localize bacteria. This is especially true of injury to certain bones. The lung is particu-

larly predisposed by catarrh. The bone is particularly predisposed by trauma.

Slight injuries predispose much more decidedly than severe injuries. Volkmann called attention to this years ago. Rose and Carless[36] say that the bacilli find "a suitable breeding ground" in "bones and joints in a state of congestion resulting from slight and overlooked injuries." When a few small vessels are ruptured or thrombosed, when trivial hyperemia arises and the vital activity of an area of cells is lowered, and when the bacilli are caught in the area, they will be apt to multiply and cause disease. In such a trivial injury says Nancrede,[35] "the hyperemia is too limited to admit of the prompt arrival and accumulation of phagocytes and alexins." A severe injury "is productive of such cell-proliferation that it will hold in abeyance the pathogenic action of the bacilli which might reach the seat of injury with the extravasated blood." (Senn[19]). After a severe injury the more prolonged hyperemia permits of a prompt arrival of phagocytes and alexins. In a severe injury retardation and stasis become marked and in this condition phagocytes in numbers and germicidal materials pass into the perivascular tissues. Traumatic cases are commoner in adults than in children. Traumatic cases give a worse prognosis than non-traumatic cases. Disorganization is more common, mixed infection is more usual, and dissemination is more apt to take place.

In a case of tuberculous arthritis, if the reality of the accident is proved, if from the time of the accident there continued to be some pain and stiffness in the part and if the symptoms suggestive of tuberculosis arise at a period not over three months from the accident we are justified in regarding the trauma as having been causal (Bosanquet[32]).

When a surgeon suspects the existence of a tuberculous joint he should always have an *x*-ray picture taken. Changes will be visible when the bacilli have attacked the bloodvessels and have produced nodules which destroy the medullary tissue.

In young children when the extremities of the bone are car-

tilaginous the *x*-rays will not be nearly so valuable in aiding early diagnosis as they are in adults. Whenever bone destruction has occurred the *x*-rays will show disease. The significance of bone changes should be interpreted by an expert.

The fact that not very unusually joints when skiagraphed very soon after an accident show no trace of tubercle and yet in a few weeks or months have become obviously tuberculous, suggests, though it does not prove, that such joints contained no old foci of disease, that the injury did more than merely aggravate an active focus or rouse a dormant area and was in reality the determining cause of the joint disease. In every case of articular tuberculosis a surgeon seeks carefully for a primary focus. He may find it in a gland, lung, in the abdomen or in another articulation. In very many cases he cannot find it. In such a case there may be no other lesion or there may be a latent area. If there is a latent area it is giving no symptoms and is probably on the road to cure. An unrecognizable latent area may be raised into activity by a traumatism inflicted at the same time as the articular injury, by cold, by shock, by exhaustion, by fear, by confinement to the house, or by the development of some complicating disease. Among the objections raised to the view that traumatism may be the determining cause of articular tuberculosis are the following:

1. That a slight injury cannot be responsible when a severe injury is not. Wilson and Rosenberger[17] say: "It is inconceivable that lesser injuries should do what greater injuries fail to do." Nevertheless, the statement that a slight injury does what a severe injury fails to do is true of typhoid disease of bones and joints—of osseous gummata—and of many cases of pyogenic osteomyelitis.

In tetanus, infection of a small puncture is more often responsible than infection of a large wound. Bone sarcoma is more common after contusions than after fractures.

Few dispute that tuberculous thecitis may follow injury. In such a case the injury is more often trivial than violent. Why should the occurrence be inconceivable in a tuberculous bone

or joint when exactly the same thing is noted, and when it is accepted in tuberculous thecitis and various other conditions? As previously stated, a severe injury promptly brings quantities of phagocytes and alexins, establishes stasis which is antagonistic to tubercle, and causes active cell proliferation.

A mild injury produces limited hyperemia. Few phagocytes are available and little alexin arrives, there is little or no protective stasis and the tissue defences are not aroused to exert an effort at self-protection.

2. Because the lower extremities suffer most often from tuberculosis but are least often injured it is urged that injury cannot be causal. As a matter of fact, the larger joints are in the lower extremities, the larger joints are apt to suffer from slight injuries, and the larger joints are most often the seat of tuberculosis after injury.

The knee is the most common seat of supposed traumatic tuberculosis.

In some other diseases of bones and joints the same predilection is shown for the lower extremities.

The femur and tibia are most prone to osteomyelitis and I know of no denial that traumatism is often the determining cause of this disease. The same is true of typhoid disease of the bones and joints. Syphilis seldom attacks the smaller bones, but is notably common in the tibia.

3. That there are many injuries of bones and joints but comparatively few cases of tuberculous disease is looked upon by some as a conclusive fact against a traumatic origin: that there are many winds but comparatively few wrecks, hence wind cannot cause a wreck—that there are many fogs but few collisions, hence fog cannot be responsible for collision—that there are many falls but few fractures, hence a fall cannot break a bone.

4. The way nature protects the joints is regarded by some as indicating that slight traumatisms are unusual; for example, the knee. "In falling and striking the knee the tuberosity of the tibia receives the impact, while the patella and the entire

knee escape direct injury, and yet the condyles of the femur are far more frequently the original site of tuberculosis than the tibia." (Wilson and Rosenberger.[17]) There are at least three answers to this statement. In the young strain of an epiphysis is a common cause and the femoral epiphysis may be strained when the tibia is contused. Muscular or ligamentous strain may be responsible, as it is known to be in typhoid spine.

The impairment of the normal activity of the part due to the injury is responsible for trauma during functionation. This is known as "functional trauma," and functional trauma may be causal as truly as strain or contusion from the accident.

5. Some assert that as mechanical stasis tends to cure tuberculosis and as injury causes stasis, injury could not determine tuberculosis. Those who put forth this assertion should go to the logical conclusion and claim that injury of a tuberculous part would cure the disease. As a matter of fact, stasis produced by the rubber band (Bier's method) is not identical with inflammatory stasis. Further, in very slight injuries there is no stasis or very slight and temporary stasis, and it is very slight injuries which are most often to blame.

I believe that it is as certain, as many things medical can be, that traumatism is often a determining cause of bone and articular tuberculosis and sometimes of tuberculosis in other regions. This view is held by numbers of able and eminent clinicians and should be recognized by all courts of law.

I have seen many cases which I regard as traumatic tuberculosis of bones and of joints, and a number of cases of traumatic tuberculosis of tendon sheaths. A striking case of bone tuberculosis occurring in my practice was disease of the sacroiliac joint arising in a sturdy miner after a wrench. There was never any evidence of any other focus. Cure followed operation.

I have seen a number of cases of traumatic tuberculosis in the knee, foot, and wrist, and several in the hip. I have seen tuberculosis of the inguinal glands after a kick, tuberculosis of the epididymis after a bruise, tuberculosis of the kidney

after contusion of that organ, and tuberculosis of the mammary gland after a blow.

A fireman in first-class physical condition fell from a roof and fractured several ribs on the right side. Pleuritis arose, traumatic pneumonia with hemorrhage developed, and the man quickly died of pulmonary tuberculosis. A postmortem made by the coroner's physician disclosed the fact that the oldest pulmonary lesions were near the bruise and directly under the adherent pleura and the injured ribs. The man's family was given a pension, and in Philadelphia a pension is paid only when death is regarded as having been directly due to an injury.

To deny the possibility of traumatic tuberculosis is to deny many of the truths of pathology and some of the plainest lessons of clinical surgery.

The possibility of traumatic tuberculosis is a necessary deduction from acknowledged facts. To affirm it seems consistent, reasonable and unavoidable even though it outrages the sensibilities and stirs the indignation of numerous corporation attorneys, who, in the words of Milton—"Ground their purposes not on the prudent and heavenly contemplation of justice and equity, but on the promising and pleasing thoughts of litigious terms, fat contentions and flowing fees."

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UNCOMPLICATED TUBERCULOUS FOCI IN BONES AND THEIR TREATMENT

By THOMAS W. HUNTINGTON, M.D.
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The term, uncomplicated tuberculous bone foci, has reference to those cases in which the focus exists (*a*) as an incipient lesion, but sufficiently advanced to cause symptoms, and suggest diagnosis, (*b*) as a lesion which has resumed activity after a period of quiescence, with a renewal of characteristic symptoms. *In neither case has it become the seat of a mixed infection nor has it invaded the adjacent joint.*

The promise of the orthopedist in dealing with lesions of this type, is based upon the belief that conservatism is his best if not only reliance.

I have always been skeptical regarding permanent cure of bone tuberculosis by orthopedic measures; rest, fixation, traction, and general systemic measures. Later observation and experience have confirmed my earlier belief. In a word, I do not accept the doctrine of the final efficiency of conservatism, and have been in search of a more rational solution of a much mooted question through early, radical interference.

In a paper upon "The Operative Treatment of Hip-joint Disease,"[1] I said, "In the entire category of surgical experiences, there is nothing more pathetic and disheartening than the humiliating failures which have followed prolonged, painstaking efforts of skilful men in this department of surgery."

John L. Porter, of Chicago, writing from the stand-point of the orthopedist, says,[2] "I doubt if there is any surgical disease

[1] Am. Jour. Med. Sci., July, 1905.
[2] Surg., Gyn., and Obst., 1913, vol. xvi, p. 334.

which has been the subject of so much controversy, or which has been subjected to such wide diversity of methods in treatment, as tuberculosis of joints, but it seems to me that each year brings a little more unanimity of opinion; that we find ourselves discarding suggestions of doubtful value and are treating each case in accordance with its own indications rather than by a method of fixed routine."

He maintains (*a*) that tuberculosis of joints in normal persons is a self-limited disease; (*b*) that in untreated cases the results are deformity and disability; (*c*) that the degree of deformity and disability depends upon the extent of time and duration of treatment.

As to the last factor he says that out of many hundreds of patients a few were well in one year, more required three years, and a larger number from three to five years. He makes no mention of unsatisfactory results nor mortality rate.

Speaking of early operation, as advocated by Ely and that which I have suggested, he says, "While these may be of value in certain selected cases, it is doubtful if they are advisable as routine methods."

Very significant are the observations of Chas. F. Painter of Boston.[1] Painter asserts that a tuberculous lesion is a constant menace to its possessor long after an apparent cure has been affected. He frankly questions the correctness of diagnosis in certain cases in the statement that many of the best results in cured cases are probably not tuberculosis.

He dwells upon the fact that tubercle bacilli live indefinitely in an encapsulated area, and fears recrudescence after the lapse of a variable interval. He states that during the past eight years 130 cases of "Pott's" and 180 cases of hip-joint disease were treated at the Kearney Hospital Clinic. A very considerable number of these cases came for secondary treatment after an interval of quiescence.

To these Painter applies the term "malignant" (recurring), and endorses the statement of Barker and Croft: that

[1] Trans. of Am. Orthopedic Assoc., 1902, Malignancy of Joint Tuberculosis.

cures reported in orthopedic statistics are wholly unreliable. He warns patients who are cured by ordinary methods of the tendency to recurrence and insists that abatement of symptoms is in no sense an assurance against later trouble.

He expresses the opinion "that exploratory interference, with a view to removal of isolated foci in children is often advisable, and is to be urged in a majority of the recrudescences if seen early."

These views regarding the clinical history of bone and joint tuberculosis are fully in accord with my own. Repeated reference by many orthopedic writers to the protracted struggle for quiescence and apparent cure is of extreme interest, and in my opinion suggests to the general surgeon the propriety of assuming jurisdiction in a field uniformly conceded to the orthopedic specialist.

Latency as applied to bone tuberculosis, as to other surgical conditions, is a word to juggle with, and to my mind is little short of a misnomer. There seems to be a close analogy between tuberculous foci and a considerable pathological group, such as gall-bladder disease, chronic appendicitis, and renal lithiasis.

No fact is better established than that alleged latency in this latter group is based upon error and is perniciously misleading. That insidiously progressive and harmful changes occur during a period of alleged latency in gall-bladder disease is beyond question.

To leave an accessible tuberculous bone focus, whether isolated or not, to smoulder until provoked to renewed activity at a later period is without justification, and seems to do violence to surgical principles. Certainly such a course in the presence of an osteomyelitis due to ordinary pathogens would be reprehensible. Can it be otherwise than true that thorough removal of the focus and surrounding tissue is as logical for tuberculous as for ordinary osteomyelitis?

Brackett, of Boston, editorially in the *Am. Jour. of Orthopedic Surgery*, says, "It is not to be expected that surgery, meaning

operative surgery, will replace conservatism, but it is to be hoped that it will shorten the long and disastrous periods of conservative methods; disastrous because of the almost waste of time in years of disability and the danger accruing to general health."

It is a matter of regret that so eminent an authority did not further elucidate his plan and explain by what technic he hopes to avoid the "almost waste of time" and prevent some of the disastrous consequences of pure conservatism.

It is a fact that resort to operative treatment has rarely been looked upon with favor during that interesting and critical period which goes before extensive invasion and joint destruction. On the contrary, radical treatment has been appealed to after conservatism has failed and when grave complications have rendered desperate measures inevitable.

The propriety of operative interference, with reference to radical cure during incipiency, depends upon two factors: (*a*) Early diagnosis; (*b*) accurate localization of the focus.

The former requirement is fundamental. The clinical history and symptom complex, together with tuberculin reactions and local joint conditions will furnish sufficient data on which to base a tentative opinion. Buxton[1] says emphatically: "The easier the diagnosis, the worse the prognosis. This applies more aptly to the treatment of this condition than to any other human ailment."

The possibility of lues must be carefully considered, and each case must be studied with reference to the acute conditions due to ordinary pathogens.

Localization in very early cases is a matter of some difficulty and may be impossible. Primarily, we know that in those bones most commonly affected, certain areas are a favorite seat of implantation. Persistent pain and tenderness over a circumscribed area are significant as pointing to the seat of disease. With fair assurance that an accessible focus lies beneath

[1] Virginia Med. Semi-Monthly, November, 1913.

the cortex within reasonable limitations, the operator need not be too precise as to its exact anatomical relations.

But final localization in obscure cases must be deferred until the focus can be identified in the radiogram.

I wish to insist that in the acute, fulminating cases delay for any purpose is extremely hazardous, and that to this type, if to no other, early incision and evacuation offers peculiar advantages.

The objects to be obtained by early, direct interference are: (*a*) Permanent cure by elimination of the focus; (*b*) reduction of time of treatment from years to months; (*c*) prevention of complications, such as abscess formation, mixed infection, disintegration of bone and joint structures, crippling deformity and loss of function; (*d*) avoidance of systemic invasion and loss of life.

Operative technic is usually simple. Every exaction in the interest of asepticity must be observed. The most available extra-articular route is to be chosen. A rather liberal incision is carried to and through the periosteum. A sufficient area of bone is exposed over the suspected part. With a trephine or chisel the cortex is removed until the opening affords easy access to the marrow. With a strong, sharp curette the end of the bone is converted into a shell-like cavity, whose dimensions must depend upon the judgment and tactile sense of the operator.

The propriety of interfering with the epiphyseal cartilage has been questioned, particularly in the very young. My opinion is that if the disease has extended from its original location across this cartilage not much respect need be paid to it; if in the remote side it will naturally be preserved. Utmost care must be exercised to avoid perforation of the cortex so as to communicate with the synovial cavity.

The resulting chamber may be dealt with variously.

Sherman, of San Francisco, after a liberal application of pure carbolic acid and alcohol, fills the cavity with normal salt solution, and closes the wound in tiers. In a series of uncomplicated cases, he has not had a failure and he commends the method strongly.

I have generally depended upon camphor phenol gauze packing (phenol one part, gum camphor three parts). The gauze is wrung dry and closely packed into the cavity. A few days later the amount of gauze is lessened and a little later is discarded. Such wounds heal rapidly and all discharge ceases in less than a fortnight under an aseptic dressing.

The great value of camphor phenol as an antiseptic is in the presence of infections, and as a safeguard in clean, open wounds seems not to be generally understood.

After removal of the initial dressing the cavity is usually free from blood, and can be filled with Beck's paste or the Mosetig-Moorhof wax. The wound may then be closed in the usual manner and fixation secured by a rather loosely applied plaster-of-Paris dressing.

I am able to report sixteen cases in which I have pursued the plan herein described, as follows: upper end of femur, three; lower end of femur, five; upper end of tibia, four; internal malleolus, two; lower end of radius, two.

In three of the operations upon the condyles of the femur, wound infection was encountered and convalescence delayed. In no case was the end result unsatisfactory, either from the stand-point of serious loss of function or of recrudescence. The mixed infections were encountered during my earlier experiences, when technic was far from perfect. The history of these cases is in marked contrast to manifold experiences had in late suppurating conditions.

I have been deeply impressed throughout with the fact that the sooner operative treatment was undertaken after diagnosis and localization, the simpler was the procedure, the shorter the time of convalescence and less was the degree of loss of function.

Attention is especially called to the three hip-joint cases noted above, in which my interest has centered, and which are already in the literature.[1]

[1] Am. Jour. Med. Sci., July, 1905; Surgery, Gynecology, and Obstetrics, April, 1906; Surgery, Gynecology, and Obstetrics, October, 1911.

Following the suggestion of Macnamara,[1] I proceeded to tunnel into the neck of the femur, through a trephine opening below the great trochanter, thereby removing most of the soft content of the neck. In one instance it was necessary to repeat the operation after a lapse of two weeks. At this time the epiphyseal cartilage was perforated, though but a small part of the head of the bone was removed.

The diagnosis in the three cases which constitute my series has been sharply questioned.

Heredity in every instance pointed to tuberculosis, and in one (a fulminating case) the patient suffered from a tuberculous lesion in the apex. The clinical history was most convincing. These patients are accessible and have been closely observed. All were well without recrudescence after a lapse of eleven, ten and eight years respectively. The average time of treatment about six months. One patient left the hospital in one month and was reported well in two months.

The functional results are as follows: One has nearly one inch shortening with motion through an angle of 35 degrees. This patient left my care permanently at the end of one month. It is fair to assume that the loss of joint function could have been measurably lessened by careful attention subsequent to the operation.

The second case has one-half inch shortening with nearly perfect function.

The third case has neither shortening nor loss of function.

Henning Waldenstrom, of Stockholm,[2] with a large experience, is an ardent advocate of extracapsular removal of the focus. He has devised what he calls "a prophylactic operation." With a slightly different technic he accomplishes a purpose similar to my own.

Sherman's experience in this field leads him to justify the method, but he insists that a focus must be localized within narrow limitations before attempting relief. In at least four cases he has succeeded admirably.

[1] Disease of Bones and Joints, 1881.

[2] Monograph, Tuberculosis of the Hip in Children, 1901.

DISCUSSION

Dr. Arthur W. Elting, Albany.

In the condition under discussion it seems to me that the great difficulty is the early diagnosis. Radiography is uncertain and for a number of years, in fact, throughout my entire surgical experience, I have been in the habit of relying on the results of the diagnostic use of tuberculin, being sure to secure a perfectly active form of old tuberculin. By this means I have been able to make a positive diagnosis in a very early stage of the disease when surgery is most hopeful.

Another point to be considered is the exclusion of certain cases treated for tnberculosis when not tuberculous in character. I have recently had called to my attention a case treated for tuberculosis of the hip based on the *x*-ray findings. The plates showed nothing conclusive to me of either tuberculosis or any other bone disease. This child was placed under observation and was given the usual test with tuberculin up to 7 or 8 mg., without any reaction. The cast, to which the child had been consigned for several months, was removed about six months ago, and I heard recently that the child is perfectly well. That experience is typical of a considerable number of cases in which the diagnosis is incorrect, and in which tuberculin is of great value.

During many years, in spite of more or less criticism of tuberculin, I have seen no unfavorable effects from its careful, intelligent use as a diagnostic agent, and I would recommend it as of the greatest value.

Dr. R. Hamilton Russell, Melbourne, Australia.

When I commenced my surgical career a good many years ago as surgeon to a children's hospital I was interested in the treatment of hip disease. I also adopted strongly the views expressed by Dr. Huntington and entered on early surgical treatment in children with great hopefulness and considerable enthusiasm. But I found my enthusiasm waned and my hopes disappointed, and finally I came as a matter of clinical experience, to adopt entirely opposite methods and to believe that the best results could be obtained by expectant treatment and rest. To a large extent by the use of this method, which is used exclusively in Melbourne, where a large amount of tuberculous ostitis and arthritis exists, do I owe my present viewpoint. I cannot discuss the question very fully, but I would like to

raise the point that nothing sounds more convincing than to speak of the early operative interference and the removal of all tuberculous foci. What is a focus in an early case? In my experience a focus that can be definitely recognized is in itself a late manifestation. If one cuts down on a bone you cannot recognize the focus as such, but you see a diffuse and extensive rarefied ostitis, and it is not until the disease has progressed for months or years that one is able to attack a definite localized focus with a centre of degenerated material. That is the answer, it seems to me, to the suggestion of the efficiency of early operative interference. Supposing this rarefied, diffuse, extensive ostitis involves the neck and trochanter, it is almost unavoidable that one will remove more than is good for the patient.

Dr. T. W. Huntington, San Francisco (in closing).

Replying to Dr. Russell's query, I have said in my paper that I do not expect to localize the focus with absolute accuracy. My object is to determine the general location and evacuate the surrounding area. If the approach to an infected area can be made by an extra-articular route I regard the operation as innocuous.

I further believe that extensive removal of intermedullary tissue can do no harm provided secondary infection be avoided. This has been done repeatedly and the period of treatment shortened from years to months. Functional results have been altogether satisfactory.

An *x*-ray demonstration of an infected area, when obtainable, is invaluable, but I am sure that very many cases can be brought to operation long before sufficient change has occurred whereby such demonstration can be accomplished.

A REVIEW OF NINETY-NINE ARTHROTOMIES FOR FRACTURE OF THE PATELLA

By H. BEECKMAN DELATOUR, M.D.
BROOKLYN, N. Y.

Twenty years ago our societies were discussing the justification of the open operation for fracture of the patella much as we are today considering the operative treatment of fractures of long bones. It was then argued that the dangers of a stiff joint following the operation were so great that a patient had better accept a partially crippled joint with ligamentous union of the patella than to risk a stiff knee following the operation.

No less an authority than the late Dr. William T. Bull took this ground. Surgeons generally are now agreed that immediate operation on the patella is entirely right and proper, but we are still divided in regard to the other fractures.

If we can convert a simple fracture of the patella into a compound one and at the same time expose the great knee-joint filled with fluid and clotted blood, without great risk, why should we hesitate to expose other fractures? The answer is, that in the treatment of the long bones we are influenced not by the fear of sepsis, but rather by the knowledge that satisfactory bony union, without operation, so generally results. The patella we know seldom can heal by bone because of the frequent interposition of fascia between the fragments.

As having some bearing on the question of the dangers of exposing fresh fractures to operation, I herewith present a review of cases of fracture of the patella, personally observed by me. The majority of the cases were operated by myself, while some were operated by my associates in the hospital service.

There were 101 fractures of the patella, and, with two exceptions, they were all subjected to the open operation.

One exception was a young woman aged twenty-three years, in whom, by indirect violence, the left patella was fractured transversely. After the accident she was able to stand, but not to walk. In this case the patient was very thin, the two fragments could be distinctly felt, and crepitus could be easily elicited. The separa-

FIG. 1.—Left knee. Operated July, 1912. Useful joint, but flexion not to right angle.

tion of the fragments was very slight. We felt that in this case the tendinous expansion of the vasti muscles had not been torn and that there was a fair chance for good union. There was also decided opposition on the part of the family to operation. The limb was placed on an inclined splint and the fragments held together by adhesive plaster placed about the fragments. The result was very satisfactory. A year later the opposite patella

was broken, and although the separation of the fragments was greater, operation was not performed because of objection by the family. In this case the result was satisfactory, although at the end of six months there was some separation of the fragments, about half an inch. A year later this had not increased. She was able to walk perfectly well without aid. Seven years later the condition had not changed.

The other was a man over seventy years of age, who obtained a satisfactory result from similar treatment.

FIG. 2.—Left knee. Operated March, 1911. Rheumatic patient, but by persistent massage good flexion was obtained.

The operations have been performed within the first forty-eight hours after the injury, except in a few cases in which it has for various reasons been delayed to a later period. The operation has not varied except as to the skin incision. At first we made a straight longitudinal incision over the centre of the knee, but found that it did not give quite as good access to the lateral tears as did the curved incision across the joint. Our incision now begins on the inner side just posterior to the centre of the inner half of the knee and on the line of the joint, and is carried upward in a curve, passing about half an inch above

the patella and then downward to the outer side of the joint to a point opposite the beginning. The flap includes the skin

FIG. 3.—Left knee. Operated August, 1909. Function of knee normal.

FIG. 4.—Compound fracture. Operated January 14, 1914. Good union. Motion still limited but improving.

and all structures down to the patella tendon. This flap is dissected down to below the lower edge of the patella and gives a good exposure of the fracture and of the joint, and also what we consider most important, of the tear extending down on either side of the joint through the tendinous expansion of the vastus muscle. This tear is caused, in most cases, by the patient's efforts to walk after the patella has broken.

FIG. 5.—Left knee. Joint motions good. The angle at which picture was taken gives an apparent distortion of joint.

After all clots and fluid blood have been carefully sponged away, the fractured ends of the bone are thoroughly freshened and exposed by dissecting-off that portion of the patella tendon which has dropped down and become adherent to the rough ends of the fragments. This we have never failed to demonstrate. We use for sutures chromic catgut No. 2. The first sutures are placed close to the edges of the fracture on either side. These are not tied until the rents in the lateral portion of the capsule have been accurately repaired. The first sutures are then tied so as to bring the posterior edges of the

fracture together. If, when these sutures are tied, the anterior edges are separated by an eighth of an inch or more, we are better satisfied because then we are sure that the tying of the anterior sutures will surely give closer apposition of the fragments. The next suture is a sort of mattress suture. It is placed crosswise through the patella tendon above the upper fracture and then carried across the tendon below the lower

FIG. 6.—Right knee. Operated November 1912. Perfect function. Simultaneous direct fracture of both patellæ, with fracture of fifth cervical vertebra and paralysis of left arm (see Fig. 7).

fracture and tied. The effect of this is to take the strain from the transverse line of sutures during the recovery from the anesthetic, when the great quadriceps muscle contracts. A final row of sutures is placed in the anterior layer of the tendinous expansion over the bone; the skin sutured with interrupted silkworm-gut or continuous silk sutures. No drainage is employed.

FIG. 7.—Left knee. Operated November, 1912. Perfect function. Simultaneous direct fracture of both patellæ, with fracture of fifth cervical vertebra, and paralysis of left arm (see Fig. 6).

FIG. 8.—Operated February 14, 1914. Good union. Motion in joint just begun.

The extremity from the toes to the upper thigh is placed in a plaster cast. This splint is left in place for ten days; it is then cut down on either side and the anterior half removed, leaving the posterior half as a permanent splint. At this time the sutures are removed and the patella grasped between the fingers and moved laterally. This movement of the patella is repeated every four or five days until the end of the third week, the patient being allowed in the wheeled chair after the second week. At the end of three weeks the cast is again removed and passive motion begun in the joint. The splint is then removed every night while the patient is in bed and reapplied in the morning. This allows of passive motion on the part of the patient when there can be no strain on the callus. If the patient resists the efforts of moving the joint to at least 45 degrees by the end of the second month, he is given an anesthetic and under complete muscular relaxation the joint is forcibly bent to a right angle. There need be no fear of refracture in doing this, provided complete muscular relaxation is first obtained. This procedure is usually successful in bringing back a rapid return of the motion of the knee.

We advise our patients to use the posterior splint while walking for at least three months. After the second month while sitting in a chair we encourage them to have the splint removed and allow the leg to bend as much as possible.

In a few cases where the patient was exceedingly muscular we have used silver wire, believing that it would be better able to stand the strain of the muscular pull when the patient was recovering from the anesthetic. In this we have been disappointed, for in two cases *x*-rays taken shortly after the operation showed the wire broken. We now use the mattress suture in the tendon, as above described, with satisfactory results.

In one case of refracture in a very muscular man, we made use of the Malgaigne hooks to hold the bone during the first week. In this case separation was quite wide and the hooks were found a very convenient way of bringing the fragments together and holding them during the suturing.

The following is a summary of our cases:

No. of patients.	Variety of fracture.	No. of fractures.
72	Simple, of one patella	72
3	Compound, of one patella	3
3	Simple, of both patellæ at the same time	6
3	Simple, of both patellæ at different times	6
2	Simple, of the same patella twice	4
2	Simple, of the same patella three times	6
1	Simple, twice, and compound a third time, of same patella	3
1	Simple, of both patellæ at different times, with refracture of one	3
87		103

There were 99 operations. All recovered from the operation. Two died while in the hospital, one on the twenty-first day of delirium tremens and one on the one-hundred-and-twenty-seventh day of pulmonary tuberculosis. In both cases the anatomical result of the operation was satisfactory.

A number of the fractures were multiple, the bone being broken in from three to six fragments. This did not seem to make any difference in the result.

There have been three cases of simultaneous fracture of both patellæ. In two the operation was done first on one side and later on the other. In one both patellæ were sutured at one sitting. This case was particularly interesting because it was a case of direct fracture, the man being thrown from a step-ladder by an electric shock. One patella was broken into five fragments and the other into three; the patient also sustained a fracture of the spine of the fifth cervical vertebra with resulting paralysis of the left arm. He made a perfectly uneventful recovery, and at the present time, sixteen months after the operation, is able to get about as well as ever and to bend the knees to beyond a right angle.

In the cases of refracture, there had evidently been perfect bony union, for at operation the point of previous fracture could not be made out. In two cases we did not secure bony union,

but in these there has been no tendency for separation of the fragments.

An interesting case was as follows: A very muscular man of forty years was brought to us with a fracture of the right patella. Eight years before this bone had been broken and successfully sutured by the late Dr. Bristow. In May, 1913, we resutured this bone and obtained an excellent result. He resumed his occupation the following August and was seen in September, when he had perfect motion in the joint and the knee looked normal except for the two scars. Three weeks later he was again brought to the hospital with a refracture of the same patella, the joint being badly infected. Drainage was instituted, extension applied, but the infection progressed and the femur and tibia both became involved. The process was finally terminated by an excision. This leaves him with a stiff joint, the only one we have in our series.

Summary of Cases Treated from 1896–1914. There were 87 patients with 103 fractures. Three cases were not operated, one refused treatment and was removed home. There were two deaths, neither directly due to operation. In ninety-nine instances the fracture was exposed and sutured. Six have useful joints but with limited motion. Forty have flexion to at least a right angle and have perfectly useful joints. The remainder we have not been able to trace; all had motion to at least 45 degrees at the time of leaving the hospital, and in our experience this has always been followed by satisfactory motion if the patient persists in his efforts to move the joint.

DISCUSSION

Dr. John J. Buchanan, Pittsburgh.

My experience in this operation is limited to thirty-five cases, and since I did my first operation I have no recollection of any case of fracture of the patella which came under my care which was not opened and sutured. The first operation was done by the original method of Lister, including the silver wire passed in one-third of an inch from the fractured border and not entering the joint, stopping just short of the articulation. My early operations were all drained, but within the last few years, according to the suggestion of Judd, I have given up drainage and now use the closed method entirely. I have never seen any harm from the drainage, no infection of joints. I have lately, within the last ten years, depended on dry wiping of the joint without irrigation. The incision in nearly all cases has been transverse, not a flap, but a transverse incision right across the line of fracture, because I think that the harm of refracture and the breaking through of the scar is a very remote possibility, and this gives a better access not only to the bone itself but to the lateral expansions of the vasti, which is of importance. The longitudinal incision is unsatisfactory, as it does not give proper access to the sides. In two cases refracture occurred, one being my first case, the refracture occurring while the patient was carrying a quarter of beef in a packing-house in Chicago. He subsequently told me he had been reoperated with a good result. The other case was a compound fracture in a patient who was allowed to go home before the time of usual discharge, and he had a refracture, and I operated a second time with good result. As far as I know there has been no one in my list of cases, and I have followed them all, who has had an immovable joint. In some cases there has been some limitation of motion at my last examination. The great majority of these patients were operated on under general anesthesia. In three or four cases local anesthesia was used with satisfaction, due to the general condition of the patient.

The best recommendation I can give to the operation is that I have been required in only one case to take out the wire, and I feel safer with a silver wire imbedded in the bone and the ends turned down. If the fracture is a stellate one, or there are a number of fragments to suture the wire is used only for the two main fragments, and the suture of the others is an absorbable one. My results have been

so uniformly satisfactory that I have not felt justified in treating such a case by external means since my first operation.

Dr. H. Beeckman Delatour, Brooklyn (in closing).

We make it an invariable rule to operate as soon as possible after the injury, usually at the end of forty-eight hours. There is no reason for waiting, and it is important to get the patient on the road to recovery.

FRONTAL SINUS SUPPURATION

ESTABLISHMENT OF PERMANENT NASAL DRAINAGE; CLOSURE OF EXTERNAL FISTULÆ; EPIDERMIZATION OF SINUS

By HOWARD A. LOTHROP, M.D.
BOSTON, MASS.

The logical treatment of most pathologic conditions is based upon an understanding of the cause. The condition with which we have to deal is that of chronic suppuration in a natural bony cavity which has a single small opening. We have to contend with changes produced by bacterial action and by mechanical obstruction.

Pathology. 1. *Acute Catarrhal Inflammation.* Following an attack of acute coryza, it is very common to observe an acute inflammation in the accessory sinuses, of which the frontal sinus is no exception. Its course is generally moderate and it is followed by complete resolution. If the ostium becomes occluded, an abscess or acute empyema may follow. This complication is more serious and the pus must escape sooner or later. This may be relieved by surgical intervention, or some wall of the sinus may ulcerate through, or relief may be spontaneous through the natural opening. Chronic suppuration is not an uncommon sequence.

2. *Chronic Catarrhal Inflammation.* This is a comparatively common condition, manifested clinically by the presence of pus in the middle meatus, together with certain subjective, and sometimes other objective, signs which it is not the aim of this paper to consider. The pathologic changes are of great

importance. The mucous membrane of the sinus undergoes the changes common to any mucous membrane which is the seat of a chronic inflammation. It becomes thickened from edema and connective-tissue proliferation, the surface is irregular and sometimes ulcerating, and there may be polypoid growths sufficient to fill and cause pressure within the sinus. The ciliated epithelium is often destroyed. The ostium is more or less obstructed so as to impair drainage permanently. In some instances the periosteum and bone may be involved but such is the exceptional result.

The subsequent course will depend upon the degree and length of time of the obstruction and also upon the nature of the secondary changes in the mucous membrane.

Treatment. The problem of the treatment of suppuration in any cavity depends upon the nature of anatomic and pathologic conditions. Let us consider the general underlying principals which govern the treatment of suppuration in the various kinds of cavities.

1. *In Soft Tissues.* If pus is evacuated from an abscess or cellulitis and efficient drainage is provided, the abscess wall collapses, the cavity becomes smaller and gradually closes from the bottom and, in a comparatively short time, the parts are healed. The closing progresses from the depths to the surface. This is what happens even in the closing of suppurating cavities within the abdomen, and we all know to our discomfort what it means to have the opening in the abdominal wall close before the deeper parts of the suppurating cavity are practically obliterated.

2. *Suppuration in Cavities with Partially Rigid Walls.* Suppuration in the pleural cavity—empyema—is a type. The cavity is made by the pus crowding the lung. In the cases operated upon early with the establishment of suitable drainage, maintained continuously until the lung gradually expands and thus obliterates the cavity, a cure is obtained.

In the chronic cases excessive adhesions and connective-tissue formation tend to prevent lung expansion. Such cases

may fail to heal, although the drainage be ample, because a large cavity with suppurating walls persists. In rare cases, under such conditions, relief may be afforded by decortication, or better, by causing the rigid and almost unyielding chest wall to sink in to meet the lung and thus obliterate the cavity. This is accomplished by extensive rib excision. Hence, suppuration in the pleural cavity will persist until the cavity is obliterated by one means or another but, if not obliterated, the subsequent course will depend upon the facility with which it drains. If the opening becomes occluded too early, acute symptoms follow; if it remains patent, the discharge continues indefinitely, varying in amount more or less according to the size of the cavity and the freedom of drainage.

3. *Suppuration in Bony Cavities with Entirely Rigid Walls.*

(*a*) Unnatural cavities, for example, in osteomyelitis of long bones. Relief is obtained only after sequestra have been removed and the cavity obliterated by granulation tissue—healing from the bottom. In the shaft of long bones the healing may take place without much subsequent scar or bony defect, but at an enlarged extremity, as, for example, the upper end of the tibia, the extensive loss of cancellated structure may leave only the cortex as a rigid wall of a chronic suppurating cavity. Destruction of this cortex, in order to obliterate such a cavity, would mean a fractured leg, which of course would be an unjustifiable procedure. Some cavities of this sort never heal, some become epidermized after a very long period, leaving a more or less deep depression, and, in rare cases, a cavity may be obliterated by some sort of graft. Much of the cell structure of the mastoid, when inflamed, presents the same situation. In all the above examples of suppurating cavities, healing takes place only by obliteration of the cavity.

(*b*) *Suppuration in Natural Bony Cavities.* Such cavities occur only in the head; they are lined with mucous membrane and communicate externally through the ear or nose. Frequently, they are the site of chronic inflammation. Relief may be obtained by efficient drainage, resulting in complete resolu-

tion, or by obliteration of the cavity, or, in a measure, by a combination of these methods, in cases where it is either unwise or impossible to entirely obliterate the cavity.

The frontal sinus is a natural cavity with rigid bony walls and the problem of treatment of suppuration depends upon anatomic and pathologic conditions. The chances of cure and differences in cosmetic effects vary according to the mode of treatment.

Let us now consider some of the methods used for the treatment of these cases.

Acute Catarrhal Inflammation of the Frontal Sinus. This paper concerns chiefly the treatment of the more obstinate cases of chronic suppuration. In passing, however, let it be said that various degrees of acute inflammation are very common, but most of these resolve spontaneously in the course of a few days without particular treatment. Very occasionally, comparatively speaking, the ostium becomes occluded and abscess with perforating of a sinus wall results, but very often, after repeated exacerbations, the process becomes chronic and some sort of surgical interference is necessary.

Let us review briefly the principles underlying the chief operative measures for the relief of chronic frontal sinus suppuration. These may be classified as (1) intranasal operations and (2) extranasal operations.

1. *Intranasal Operations.* Certain anatomic features will be discussed in detail later, but, suffice it to say here, that the sinus drains through a comparatively small opening in its floor in close proximity to several anterior ethmoid cells and the extreme upper front portion of the middle turbinate bone. Attempts to cure all chronic cases should be made first by intranasal methods. These consist in the removal of the anterior portion of the middle turbinate and the breaking up of as many anterior cells as possible, the object being to establish free drainage. Many patients obtain satisfactory relief by this means. Attempts may be made to probe the sinus, but there is always some doubt as to the success of such attempts, for reasons so frequently

recorded by anatomists and clinicians. More radical intranasal methods are recommended and practised by some. These include the operations which aim to enlarge the frontal opening by means of burr drills and different types of raspatories, aided by the use of shields of different shapes and other guides to prevent injury to the bone posterior to the ostium. It is possible to probe some sinuses and then to enlarge the bony opening by these methods and obtain beneficial results. On the other hand, it is perfectly obvious in the greater number of cases that the probe is not positively in the sinus and that the operator has absolutely no means of knowing the bony relations and, therefore, can never be reasonably sure of just what he is doing. The distances around the ostium are so short, the portions of bone to be removed so thick, and the bone protecting the dangerous structures so thin, that I am firmly convinced that what amounts to "blind operating" is unwise, particularly when there are other methods which allow of a certain amount of vision. These more radical intranasal methods involve far greater risk to life, for reasons so often detailed by others, than the external operations in which we are better able to see just what is being done. Furthermore, I believe that all very radical operations for the cure of chronic suppuration are serious and should not be looked upon lightly. The parts are so small and the importance of removing all bone around the ostium so great, that I believe it can be accomplished only by the aid of vision, which ensures both precision and safety. Hence, to summarize, I would say that, primarily, in all cases the front of the middle turbinate and cells and growths in the vicinity lying below the ostium should be carefully removed and then some weeks allowed to elapse in the hope that a satisfactory cure will follow. Although I think that the complete removal of the nasal floor of the sinus is the essential factor in the cure of these cases, I believe that the nasal route is inefficient and unnecessarily dangerous even in skilled hands.

2. *Extranasal Operations.* The object of all operations is to cure the condition. There are two general types of extra-

nasal methods: one aims to enlarge the natural opening and the other is a destructive method which aims to obliterate the sinus. Some methods tend to combine these principles. It seems to me that most of the very radical methods simply offer different degrees of exposure of the sinus, and, if the sinus is one that cannot be obliterated, a cure does not follow because the essential cause is not removed. In other words, the removal of the facial and orbital walls does not affect the size of the region of the ostium where the opportunity for enlargement is none too good at best. However, this general removal of surfaces does do good and in many cases is followed by satisfactory healing because the sinus is practically obliterated or made so small that it is no longer troublesome, but the cosmetic results are unsatisfactory.

(*a*) *Operations to Reëstablish Drainage.* The Ogston-Luc operation, described by the former in 1884 and modified by the latter in 1894, is essentially a curetting of the cells around and below the ostium, chiefly through an opening in the facial wall. Modifications consist in the use or not of different types of temporary nasal or external drainage, but, finally, events must be left to take a natural course. Relief might follow but failures have been so common that more radical measures were adopted. Failure was, of course, due to recurrence of obstruction at the ostium, sometimes followed by an external fistula. Although the Ogston-Luc operation has been given up largely for the more destructive methods, its conception was in the right direction so far as combining a cure and good cosmetic results is concerned.

In this group we have also various osteoplastic resections combined with curetting around the ostium, one of which the writer devised and published in 1898. I believe these are unwise because it is not good technic to attempt plastic bone surgery around such suppurating cavities. The risk of spreading infection is great, the flap of bone is prone to necrosis because of the lack of nutrition, and its loss is followed by unnecessary deformity.

(*b*) *Efforts to Obliterate the Sinus.* Most of these operations combine a certain amount of curetting of ethmoid cells with that of the whole sinus; some do not disturb the floor of the sinus.

In 1894, Kunt suggested the removal of the facial wall so as to allow the skin to come in contact with the cerebral wall of the sinus; this would fail to obliterate a deep sinus.

Jansen's plan, formulated in 1893, was to remove the orbital floor; this would not obliterate a high sinus.

In 1898, Riedel resected both facial and orbital walls; this was more likely to obliterate the sinus, but deformity is very marked.

In these attempts at obliteration, obstinate and troublesome pockets of pus persist in distal portions of large sinuses, so that suppuration and fistulæ continue.

In 1902, Killian suggested the resection of the orbital and facial walls, including a considerable portion of the nasal process of the superior maxilla, but left a bridge of bone along the supra-orbital arch so as to lessen the subsequent deformity. He includes also a thorough curetting of the neighboring cells and removal of a portion of the nasal crest of the frontal bone.

These four methods represent the general types of obliterative operations and various modifications of each have been devised. The Killian is the most radical and probably gives the greater percentage of cures. Failures are not uncommon and even here eventual deformity and occasional sequelæ persist. In the Killian method, if the sinus cannot be obliterated, the avenue of escape of exudate into the nose is narrowed because the soft parts fall in and are drawn in by scar tissue at the level of the site of the ostium because the support given by the upper portions of the nasal process and lachrymal bones is gone. Although one sees it stated frequently that the Killian operation is the final word in frontal sinus operations, still the results demonstrate that there is much more to be desired.

Some General Considerations. The essential cause of continued frontal sinus suppuration is inadequate drainage which, in turn, may be followed by aggravating complications. Relief may be

obtained by obliterating the sinus, or by establishing adequate drainage. The former cannot always be accomplished and it always results in objectionable deformity. On the other hand, it is not easy to obtain the desired amount of drainage. We must decide in each case, considering all the evidence at hand, whether we shall endeavor to obliterate the sinus or provide adequate drainage. The larger the sinus, the more difficult will be the task of obliterating it, and the more objectionable will be the deformity. On the other hand, the larger sinus is more easily drained and open to subsequent intranasal treatment, which is required after most sinus operations. If we can obtain a cure without bony deformity, this of course is desirable. In a general way, the larger the sinus the more trouble it causes, because of its increased area for suppuration and its greater capacity for granulations and polypi. The technic to be described seems to me to be particularly indicated when the sinus is large, when both sinuses are affected, or when an external fistula is present, and it should afford relief also after other methods have failed. The method avoids injury to the orbital contents, such as result in cellulitis, double vision, and inflammation of the lachrymal sac. It ensures easy access for the subsequent treatment of granulations, while the distal narrow angles and borders tend to become obliterated by scar tissue and the size of the new ostium, which can readily be kept open, prevents the retention of exudate until, finally, the remaining walls of the sinus cease to give rise to exudate and become covered with smooth scar tissue or mucous membrane. The ostium can be made actually as large as the anatomy will allow while the natural bony outline is preserved. If we are striving to get drainage, then I believe that the principle of the Killian and such operations is at fault, because, by the removal of the upper portion of the lachrymal bone, the nasal process, and the immediate adjacent part of the frontal bone, we take away bony support just where we need it and thereby allow the soft parts to fall in and be drawn in by contraction at a point where every fraction of an inch is most valuable.

The various external operations differ chiefly in the method of approach to the sinus, but the real issue is that of efficient drainage.

Hence, if the intranasal efforts for drainage described above fail, I believe we should attempt to establish it by the use of a method which is a combination of both the internal and external routes.

Anatomy. In considering the anatomy of the frontal sinus, the description will be limited to the structure and topography of those portions which are of practical importance in carrying out the technic of operation to be described later. Some years ago the writer published in detail the descriptive anatomy of this sinus and the anterior ethmoid cells (see Frontal Sinus and also Turbinate articles), but the following features are more particularly of operative importance.

All of the sinus is in the frontal bone. The sinuses vary in shape and size but, in a general way, present three surfaces and a base. The inner portion of the base and the posterior angle are situated above the extreme anterior portion of the nasal cavity and some of the anterior ethmoid cells (Figs. 9 and 17). The *posterior* or cerebral wall is in front of the frontal lobe of the brain and, although comparatively thin, the bone is dense in structure and not easily injured. This wall should be carefully avoided. The *anterior* or facial wall is the thickest, is more or less cancellated, and is the avenue of approach in most so-called external operations. Its extent, thickness and outline vary according to the size and shape of the sinus. The usual exploratory opening is made a little above the extremity of the nasal process of the superior maxilla (Figs. 1, 2, and 19), because the smallest sinus occupies this position. Very thick bone at this point is an indication that the sinus must be very small and does not rise to this level. For practical purposes such a sinus amounts to no more than an ethmoid and, of itself, could not be of much pathological importance.

The *floor of the sinus* is of the greatest surgical importance and consists of an outer or orbital portion, and an inner or nasal

portion (Figs. 1, 7, 8, and 11). The orbital portion is comparatively thin but dense. It has an attachment below for the pulley of the external oblique muscle, the dislodgement of which is undesirable. The more or less complete removal of the facial and this portion of the floor of the sinus is carried out in some operations directed toward the obliteration of the sinus, result-

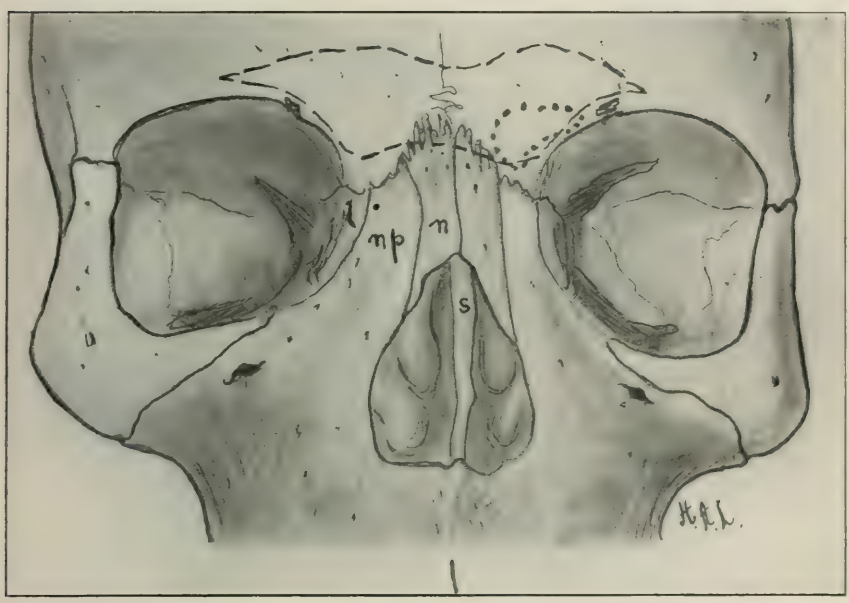


FIG. 1.—Front view skull. Projected outline of frontal sinus and opening into it. *n*, nasal bone; *np*, nasal process of superior maxilla; *s*, septum of nose; *l*, lachrymal bone.

ing in deformity according to the size of the sinus and the method adopted. The size and shape of some sinuses preclude obliteration.

The nasal portion contains the single ostium (Figs. 15 and 17) leading to the nose, and is made up of both very thin and very thick areas of bone. It is bounded externally by the suture between the lachrymal and frontal bones and somewhat by the suture between the nasal process and the frontal bone (Figs. 1, 7, 8, and 17). Internally it is bounded by the interfrontal

septum, which is the upward projection of the plane of the nasal septum, although it may not necessarily be in the median line (Figs. 5, 11, 13, and 17). In front the boundary lies roughly behind the upper border of the nasal bone and the nasal process of the superior maxilla (Figs. 8 and 9). Although these bones do not form part of the wall of the sinus, they bear an important surgical relation to its floor. Posteriorly, the floor of the nasal

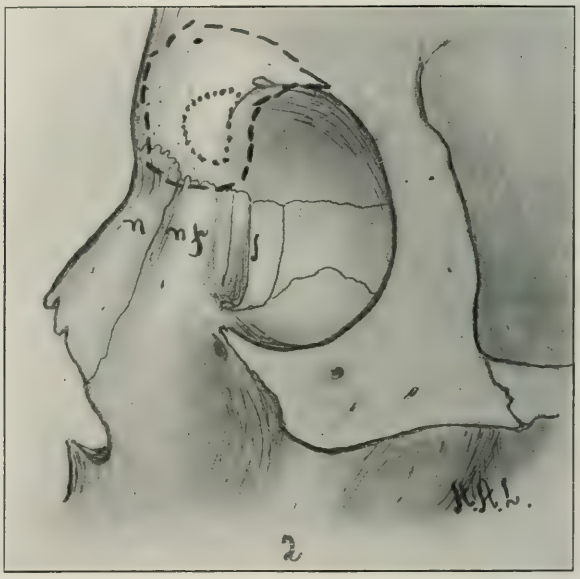


FIG. 2.—Side view showing projected outline of sinus and opening into it. *n*, nasal bone; *np*, nasal process; *l*, lachrymal bone with groove for sac and duct.

portion comes to an angle made by three surfaces—floor of sinus, cerebral surface, and interfrontal septum (Figs. 4, 8, and 17). Toward this angle is situated the ostium. The floor in the vicinity of the ostium is made up of thin bone which forms the walls of some of the anterior ethmoid cells. External to the ostium are the cells, completed by the lachrymal bone. Posteriorly one meets oftentimes an ethmoid cell protruding into the sinus called the frontal bulla, and behind this are other anterior

and then the posterior ethmoid cells (Figs. 9, 10, 11, 15, and 18). In front of the ostium one is apt to meet an anterior cell and still further in front is the so-called nasal crest of frontal bone (Figs. 7 and 8), and still in front are the thick and dense upper ends of the nasal bone and nasal process of the superior

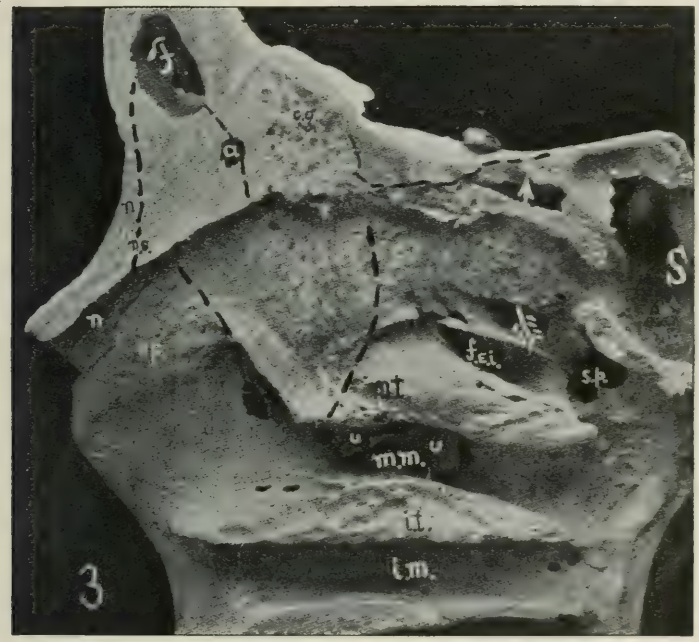


FIG. 3.—Outer bony wall of right nasal fossa. *F*, frontal sinus; *S*, sphenoidal sinus; *s. p.*, sphenopalatine foramen; *f.e.i.*, inferior ethmoidal fissure: arrow enters a posterior ethmoid cell from a middle ethmoid fissure; *a*, an anterior ethmoid cell which makes a frontal bulla; *n*, nasal bone; *n.s.*, nasal spine of frontal bone; *n.p.*, nasal process of superior maxilla; *m.t.*, middle turbinate bone; *m.m.*, middle meatus; *u*, uncinate process; *i.t.*, inferior turbinate; *i.m.*, inferior meatus. Dotted line shows the portion of bone to be removed.

maxilla (Figs. 12 and 13). Internal to the ostium and below it are thin lamellæ of bone subject to some immaterial variation, according to whether the ostium leads to the infundibulum or still further internal, so as to open under the forward projection of the middle turbinate bone (Figs. 8 and 15). In all

instances the frontal sinus can be said to open into the nasal cavity through the anterior upper portion of the ethmoid bone (Figs. 9, 15, and 18).

Hence the ostium is surrounded on all sides by thin bone which may be fractured with comparative ease and thus a

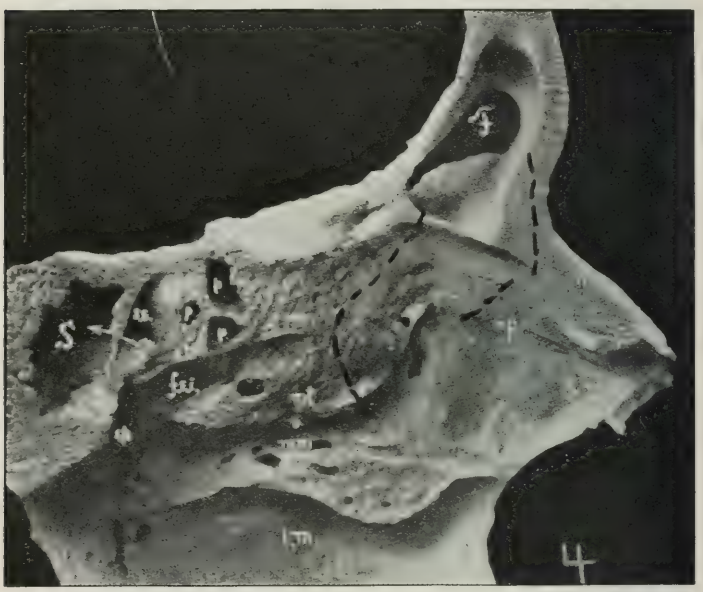


FIG. 4.—Outer bony wall of left nasal fossa. *F*, frontal sinus; *S*, sphenoidal sinus into which an arrow points passing through the ostium sphenoidale; *n*, nasal bone, *n.p.*, nasal process of superior maxilla; *p*, *p*, broken posterior ethmoid cells; *s.t.*, superior turbinate; *f.e.i.*, fissura ethmoidalis inferior; *s.p.*, sphenopalatine foramen; *m.t.*, middle turbinate; *u*, uncinate process *m.m.*, middle meatus; *i.m.*, inferior meatus; *i.t.*, inferior turbinate. Dotted line shows the portion of bone to be removed.

larger opening made. If this thin bone is broken away, and this is usually what is accomplished by the majority of operators, what seems to be a reasonably large opening to the sinus is obtained. This may suffice for the cure of many cases, but many failures follow because the opening becomes obstructed later.

If the under surface of a disarticulated frontal bone be observed (Fig. 7), the opening into the sinus will be found to correspond to the enlarged opening just described by breaking the walls of anterior ethmoid cells. It is commonly stated

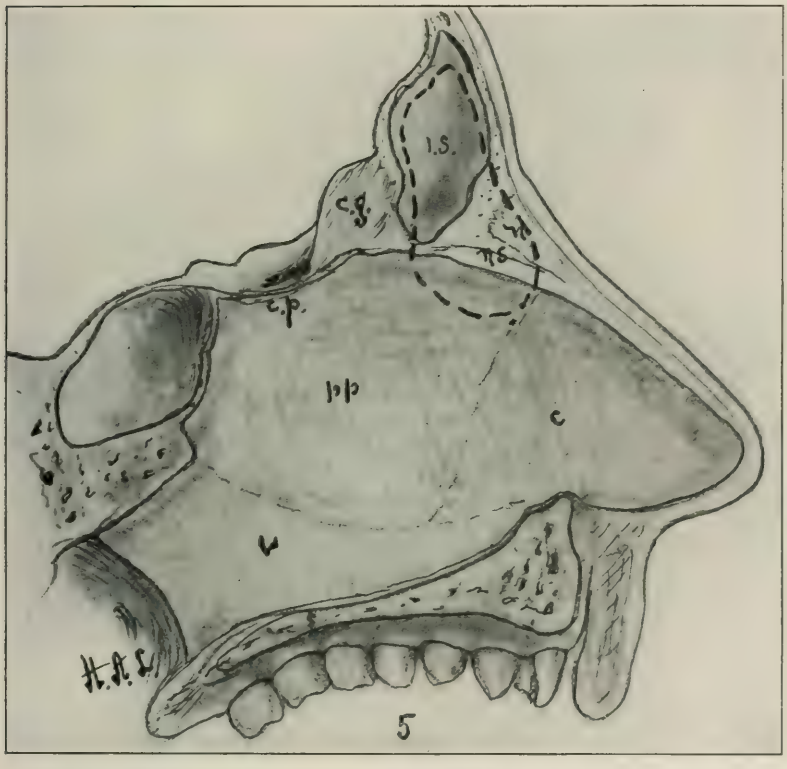


FIG. 5.—Shows interfrontal and nasal septum. *n*, nasal bone; *ns*, nasal spine of frontal bone; *c.g.*, crista galli; *c.p.*, cribiform plate; *pp*, perpendicular plate; *v*, vomer; *c*, triangular cartilage. Dotted line shows the portion to be removed in operation on both sinuses.

that this is the full extent of enlargement that the anatomy will allow, although some include the thin portion of the nasal crest of the frontal bone in this removal. Nevertheless, an opening in many instances nearly as large again may be obtained by removing a portion of the frontal bone which articulates with

the nasal bone and nasal portion of the maxilla, together with the adjacent thick portion of these two bones (Figs. 8 and 13). This will be considered further later on. Internal and posterior to the ostium is a dangerous region which, as a rule, should be carefully avoided because of the risk of breaking into the cranial

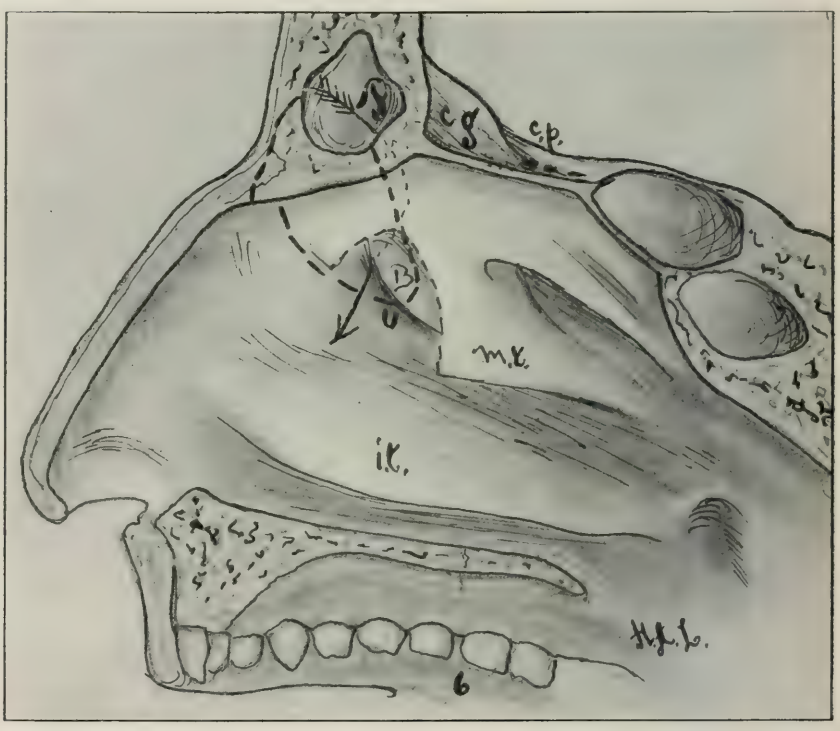


FIG. 6.—*F*, frontal sinus; arrow passes through its ostium coming out through the infundibulum at the hiatus semilunaris; *cg*, crista galli; *c.p.*, cribriform plate; *m.t.*, middle turbinate; *i.t.*, inferior turbinate; *B*, ethmoid bulla; *u*, unciform process. Dotted line shows the bone to be removed whether for single or double sinus.

cavity (Figs. 9 and 17). The ostium is about on a level with the cribriform plate and the slit for the nasal nerve is internal and rather close to it, hence the great importance of the early introduction of a probe through the ostium which should be left there as a guide during the early part of the operation.

If a frontal bone be disarticulated, the following features will be observed in the region of the floor of the sinus around the bony opening, now comparatively large because the ethmoid cells are removed (Fig. 7). Externally is seen the line of articulation with the lachrymal bone and posteriorly the ethmoid cells. Posteriorly and internally is found the front end of the cribriform plate (Fig. 8), in front of which is a comparatively

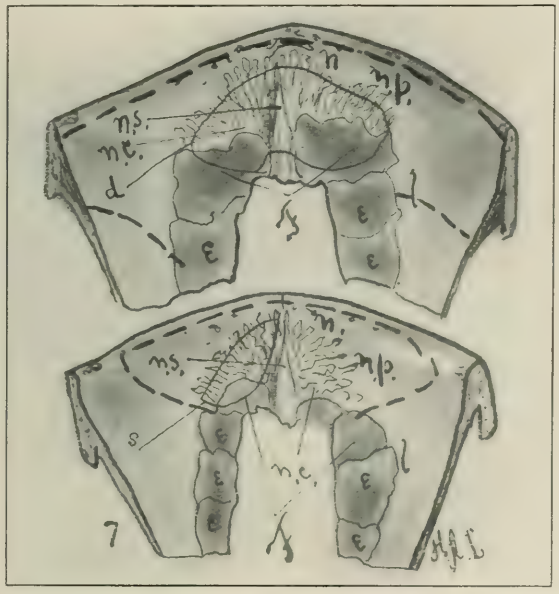


FIG. 7.—Portions of frontal bones, under surface. *F*, opening to frontal sinus; *n*, for articulation with nasal bone; *n.p.*, with nasal process; *l*, with lachrymal bone; *e*, for completion of ethmoid cells; *n.s.*, nasal spine; *n.c.*, nasal crest; *s*, thick bone to be removed for a single sinus; *d*, for a double sinus.

thin horizontal portion of the frontal bone called the nasal crest. This forms the inner boundary of the ostium. In front of the ostium, extending forward and toward the median line, is a dense and thick portion of bone of considerable area where the nasal process and the nasal bones articulate (Figs. 3, 4, 5, 8, and 13). This is a portion of the floor of the sinus which is not fully made use of in sinus operations.

In the median line, still a part of the floor, particularly if we consider the two sinuses together, we observe the thickened portion of the frontal bone where the perpendicular plate of the ethmoid bone articulates and, in front of this, the spine of the frontal bone (Figs. 5 and 14). In Figs. 3 and 4 we note the extreme upward and forward prolongation of the middle turbinate bone, external to which are the infundibulum and ethmoid cells, subject to comparatively immaterial individual

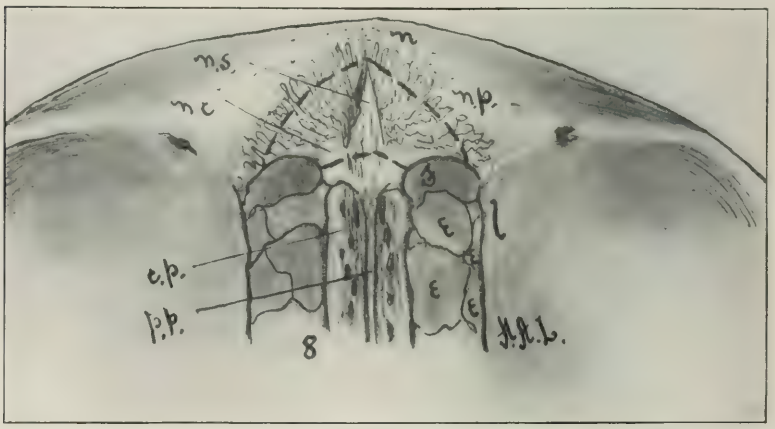


FIG. 8.—Under surface of frontal bone with cribriform and perpendicular plates. *F*, natural bony opening into frontal sinus; *n*, for articulation with nasal bone; *n.p.*, with nasal process; *l*, with lachrymal bone; *n.s.*, nasal spine; *nc*, nasal crest. Dotted line shows the extent of bone to be removed in operating on both sinuses.

variations as to ostia and cells. Internal to this lamella of the turbinate is the extreme anterior end of the roof of the nasal fossa formed in part behind the cribriform plate (Fig. 8).

If, on the other hand, we look down upon the section after the frontal bone has been removed (Figs. 9 and 10), we observe again the structures around the bony opening from the sinus. The lachrymal bone and groove for the lachrymal sac are to be seen externally, and behind are the ethmoid cells and cribriform plate; internally is the perpendicular plate, and in front are the thick upper extremities of the nasal bones and the nasal

processes of the superior maxillæ. Hence these two views (Figs. 9 and 10) demonstrate why a probe is left in the ostium during the early stages of the operation to serve as a guide to enable us to avoid destruction of bone posterior and internal to the ostium. These views indicate also the bone which may be removed in front and external to it.

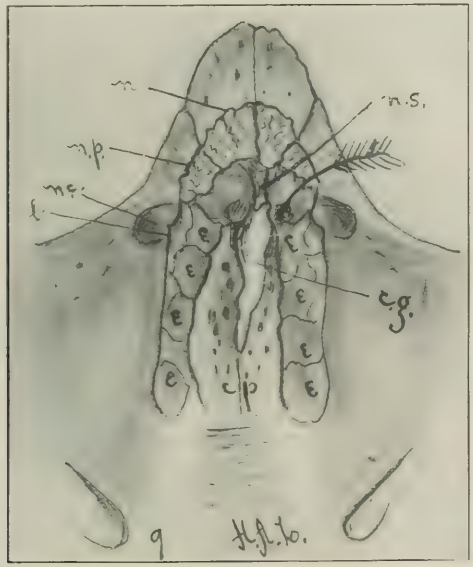


FIG. 9.—Showing structures under frontal bone. *n*, nasal bone; *n.p.*, nasal process; *l*, lachrymal bone; *n.c.*, nasal canal; *c.g.*, crista galli; *c.p.*, cribriform plate; *e*, ethmoid cells. Arrow through ostium of right frontal sinus.

The distance between the front end of the cribriform plate and the upper ends of the nasal bones (Figs. 7, 8, 10, 17, and 21) is also subject to variation, and the knowledge of this distance before operation is of great importance. This can be determined by *x*-ray examination (Figs. 21 to 26). A lateral view of this region will add to an understanding of its topography (Figs. 4, 5, 10, and Figs. 21 to 26). Near the median line (Figs. 4 and 5) the thinner portion of the sinus floor shows posteriorly, and in front it becomes very thick and dense, made up of the perpen-

dicular ethmoid plate, nasal crest, nasal spine, and upper end of nasal bone. A little more lateral the floor has become much thinner posteriorly, but in front the nasal crest and upper end of nasal process of superior maxilla are still very thick. Sagittal sections (Figs. 3 to 6, and Figs. 21 to 26) demonstrate this very thick bony ring in the anterior portion of the sinus floor.

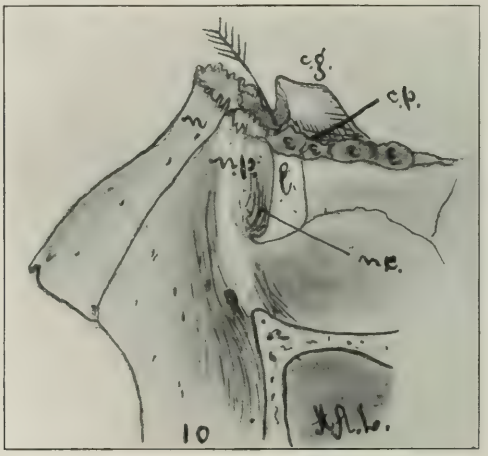


FIG. 10.—Side view of Fig. 9. Same lettering.

The arrangement of ethmoid cells below the sinus will not be considered here in detail because they have been considered so frequently in other publications. Those having particular bearing are in immediate relation with the lachrymal bone, the inner aspect of the nasal process, and the so-called agger nasi cell, often present at the extreme end of the middle turbinate.

The *internal* wall of the frontal sinus is the interfrontal septum and its extent and position and the existance of frontal septa should be determined by *x*-ray examination. The septum is practically in the median line, but of course is subject to some variation. Its central portion is thin and its circumference thicker, particularly below, where it continues as the septum of the nose (Figs. 5, 11, and 13). At its lower, posterior angle is the crista galli, which is separated by the posterior wall of the

sinus. Occasionally the sinus itself projects into the crista galli, a fact which should be borne in mind. However, this angle is behind the guiding probe and should never be interfered

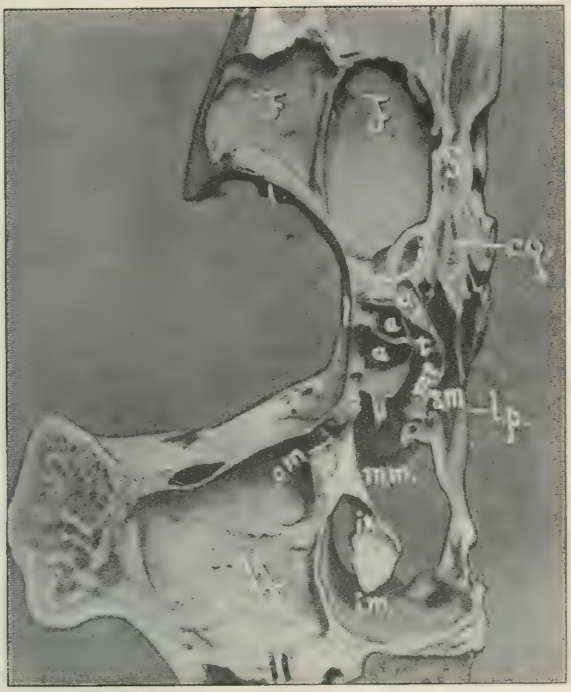


FIG. 11.—Bone. Coronal section through ostium maxillare; anterior half. Posterior wall of frontal sinus removed. *F*, an anterior wall of frontal sinus showing a vertical septum; *S*, septum between the frontal sinuses; *i.t.*, inferior turbinate; *m.t.*, middle turbinate; *o.m.*, ostium maxillare; *u*, uncinate process; *l*, os lachrymale; *t*, turbinate fossa; *a*, *a*, *a*, anterior ethmoidal cells internal to lachrymal bone; *A*, antrum of Highmore; *l.p.*, lamina perpendicularis; *c.g.*, crista galli; *i.m.*, inferior meatus; *m.m.*, middle meatus; *s.m.*, superior meatus; *i*, inferior wall of frontal sinus (orbital portion). Dotted line corresponds to nasal portion.

with. The front corner of the cribriform plate may project well into this angle at the base of the crista galli (Figs. 9 and 17).

Hence, to summarize the practical points brought out by the above:

The region of the ostium of the sinus is surrounded by thin bone.

The whole nasal floor of the sinus represents the maximum area for the acquiring of drainage.

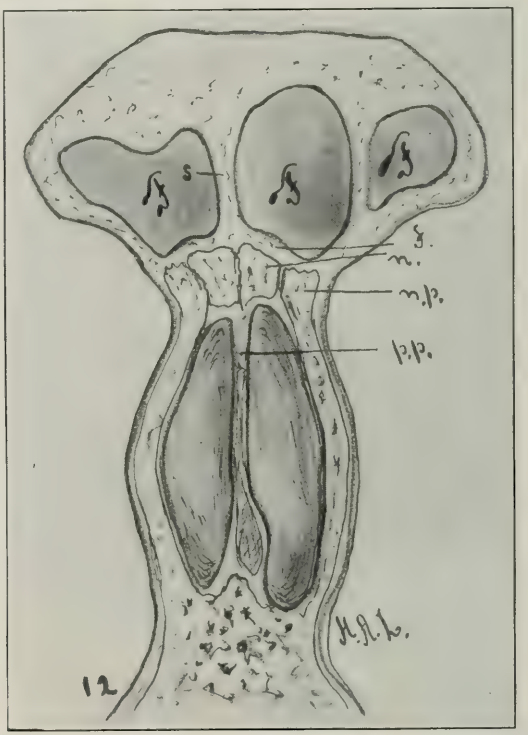


FIG. 12.—Sagittal section at base of nasal bones, looking forward. *F*, frontal sinuses with a partition in the right side; *f.*, frontal bone; *n.*, nasal bone; *n.p.*, nasal process; *p.p.*, perpendicular plate of ethmoid; *s*, interfrontal septum.

The area posterior and internal to the ostium is comparatively small, and it is too dangerous a region for interference, although, with great care, a protruding ethmoid cell may be destroyed.

The area in front and external to the ostium is by far the larger and is comparatively thick and dense. All of this may

be removed with comparative safety by means of special instruments.

The partition between the sinuses and its continuation into the nasal septum (perpendicular ethmoid plate) may also be removed without risk and thus extra space be gained.

X-ray examination in two planes must be made before operation, in order to determine certain relations which are variable.

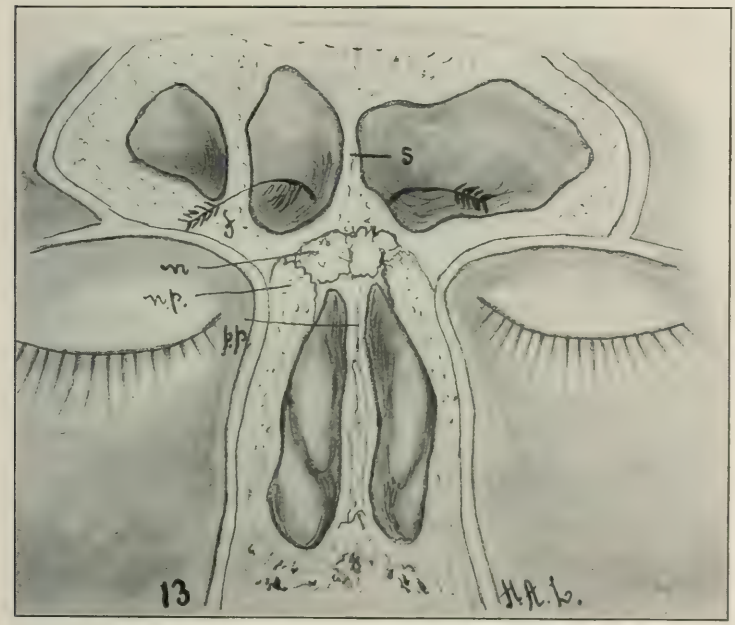


FIG. 13.—Same as Fig. 12, looking backward, same lettering. Arrows directed toward posterior angles to frontal ostia.

A clear understanding of the lymphatic and venous channels of drainage is necessary in order to determine subsequently the extent and location of infection. There is some drainage into the superior longitudinal sinus and also into the lymph-vessels of the cranial cavity.

Röntgenologic Examination. The Röntgen portrayal of the conditions in and about the sinus is of great importance, partly as

FIG. 14

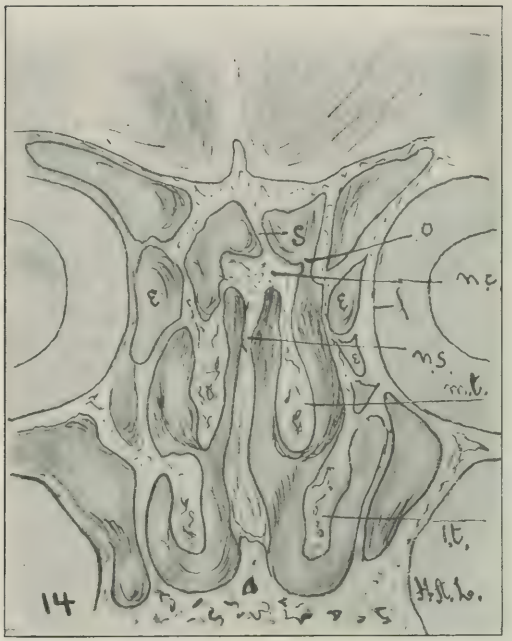
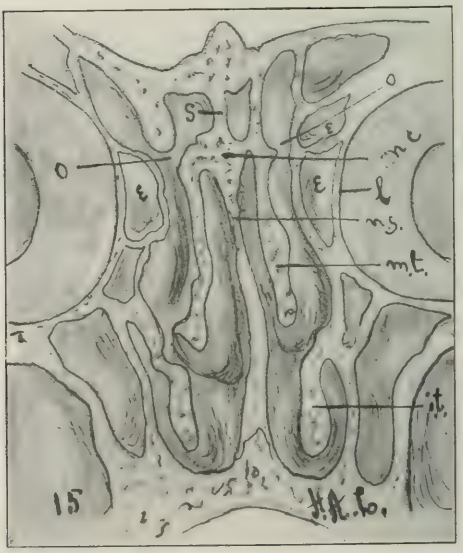


FIG. 15



FIGS. 14 and 15.—Section of same specimen through region of ostia of frontal sinus—first looking forward and then backward, same lettering. *S*, interfrontal septum; *n.s.*, nasal septum; *o*, ostium frontale; *n.c.*, nasal crest; *m.t.*, middle turbinate; *i.t.*, inferior turbinate; *e*, ethmoid cells; *l*, lachrymal bone.

an aid to diagnosis, but particularly as a means of determining the site and dimensions of the sinus.

Slight pathologic changes in the region could not be detected, but extensive alterations in the density would be evident. Hence, as an aid to diagnosis, the skiagraph may be of some value, but other signs are of greater importance. I believe the chief value of *x*-ray examination is the portrayal of the anatomy of the region, for thus we are enabled to picture anatomic features

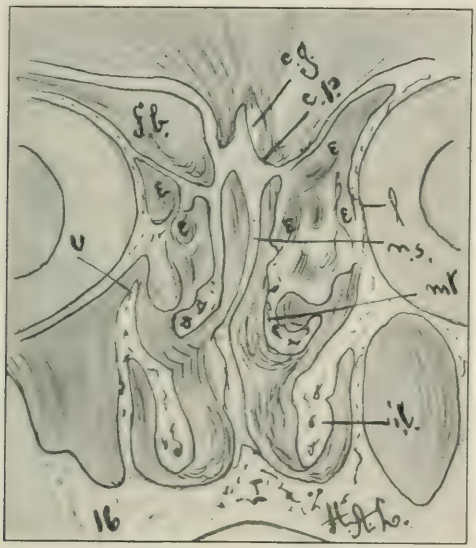


FIG. 16.—Same specimen, section behind crista galli and ostia of frontal sinus, looking forward. *c.g.*, crista galli; *c.p.*, cribriform plate; *n.s.*, nasal septum; *f.b.*, frontal bulla; *e*, ethmoid cells; *l*, lachrymal bone; *mt*, middle turbinate; *i.t.*, lower turbinate; *u*, unciform process.

of paramount importance. The site of the sinus can be established so that the exploratory opening can be made with the assurance of entering it. The lateral views will determine the amount of space between the front end of the cribriform plate and the base of the nose, a factor of great importance in the technic to be described.

Two views should be made—an anteroposterior and a lateral one. More than ordinary precision is required, both as to

symmetry and point of focus. Dr. Percy Brown has devised an apparatus for fixing the head and obtaining most satisfactory skiagraphs in these difficult cases, and to him I am also indebted for the illustrative prints ("The Diagnostic Evidence Obtained from *x*-rays from the Lateral Aspect of the Skull," *Boston Medical and Surgical Journal*, June 12, 1913). Anteroposterior views give us the height of the sinus, the level of the cribriform plate, and the width of the space between the lachrymal bones.

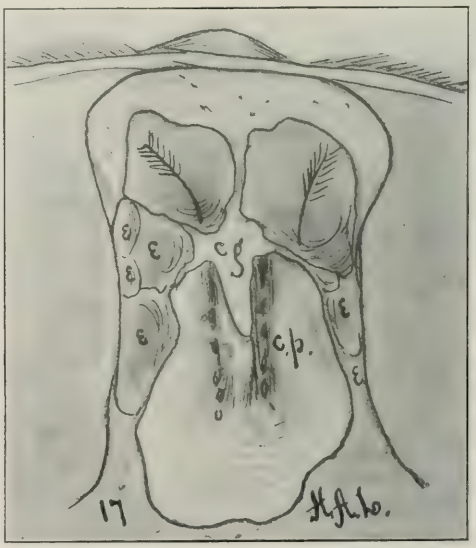


FIG. 17.—Horizontal section just above level of cribriform plate (*c.p.*); *c.g.*, crista galli. Arrows in frontal sinuses directed toward ostium. *e*, ethmoid cells.

The lateral views show all the anteroposterior dimensions, particularly the available space for enlarging the opening, and the position of the crista galli and the front end of the cribriform plate. The base line of the cranial cavity can always be demonstrated.

Transillumination is not of much diagnostic or operative value, and reveals nothing that cannot be discovered by other means. A sinus filled with pus or hypertrophied tissue or a small sinus

might be suspected as a result of such examination. No operative guides can be made out. Hence contributory evidence may be obtained.

Technic of Operation. Preliminary to any external operation upon the sinus, effort to cure by intranasal methods along safe lines should have been thoroughly tried. This means that the

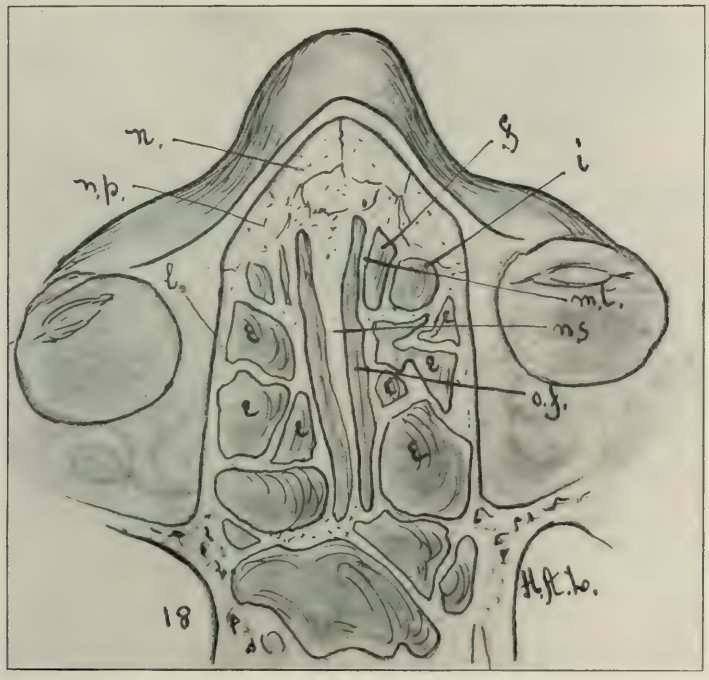


FIG. 18.—Horizontal section of same specimen just below level of cribriform plate. *n.*, nasal bone; *n.p.*, nasal process; *l*, lachrymal bone; *n.s.*, nasal septum; *m.t.*, upward continuation of middle turbinate; *o.f.*, olfactory fissure; *f*, leading to frontal sinus; *i*, infundibulum; *e*, ethmoid cells.

front of the middle turbinate has been removed and many anterior ethmoid cells broken through. X-ray findings should have been carefully studied. Application of a 4 per cent. solution of cocaine and adrenalin (1 to 2000) to the extreme upper front portion of the nasal cavity will lessen materially the amount of hemorrhage. The usual bone cutting instruments

and slender curettes should be selected, but the essential portion of the operation is performed solely by means of burr drills of selected sizes mounted on curved and straight shanks. The burr drills devised by Tilley and Ballinger for antrum operations serve our purpose well, particularly those with the curved shank.

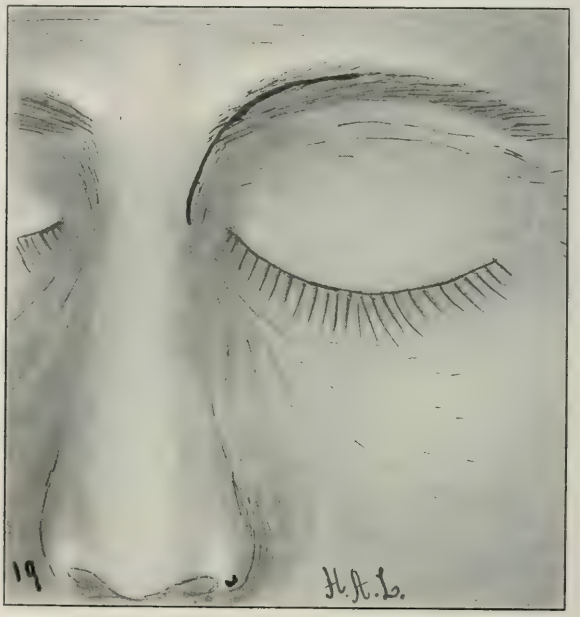


FIG. 19.—Showing skin incision.

The patient is placed in a sitting posture and the head kept horizontal most of the time. There is less shock when the patient is placed semirecumbent, and this position may be selected, but greater caution is needed to keep in mind the anatomic relations and hemorrhage may be more troublesome.

In order to avoid the annoyance of blood escaping into the pharynx, the posterior nares may be plugged or, better still, narrow strips of gauze may be introduced *via* the anterior nares, leaving the front half of the nasal fossa free for operation. Ether should be administered through a tube entering the mouth to the pharynx, so as to avoid any delays or annoyance from this source.

The incision is the middle portion of the one used in the Killian operation and, in fact, the one adapted for most of the frontal sinus operations. It extends from about the centre of the unshaven eyebrow inward and then downward a short distance on the outer side of the nose. The supra-obital nerve

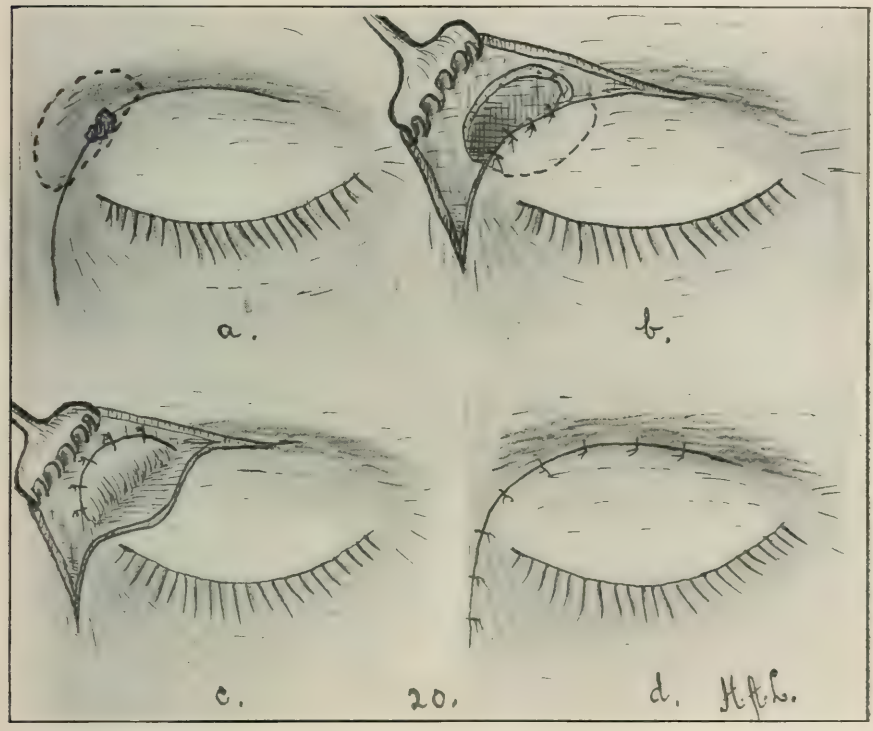


FIG. 20 —Epidermization of frontal sinus. *a.*, shows scar, fistula and opening in bone; *b.*, bone exposed, edge of lid sutured, outline of skin flap; *c.*, flap sutured in place over opening to sinus; *d.*, wound closed.

may be spared in some cases (Fig. 19). An area of bone at the base of the nasal process and nasal bone and above is exposed and denuded of periosteum. The sinus should be entered just above the base of the nasal process (Fig. 2), easily accomplished by means of small chisels and gouges, and enlarged by rongeur forceps. The sinus is then explored by means by a small probe.

The ostium will be found situated toward the posterior angle. Pass the probe down into the nose and out through the anterior nares. The upper end should protrude through the wound and be bent so that the probe will stay in place of itself. Pass small curettes from above down through the floor of the sinus, always in front of and external to the probe at the ostium. Thus, the thin walls

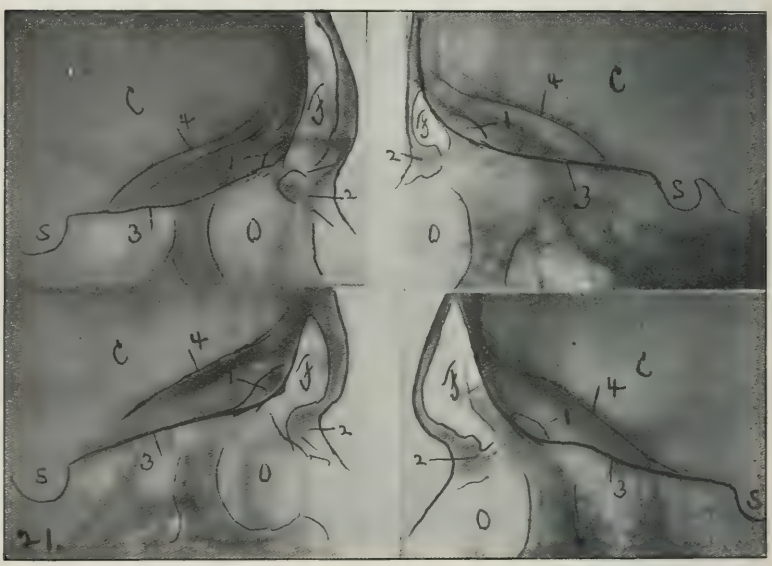


FIG. 21.—Tracings over lateral skiagraphs to show the dense bone at floor of frontal sinus in front and the relative distance between the base of the nose and the crista galli, most of which can be utilized. 1, crista galli; 2, dense bone made up of nasal and frontal bones and nasal process of superior maxilla; 3, cribriform plate continuing forward in the general curve of the cranial cavity; 4, roof of orbit; *F*, frontal sinus; *O*, orbit; *C*, cranial cavity; *S*, sella turcica.

of anterior cells are broken up until the ostium becomes considerably enlarged. During these manipulations or earlier the walls of the sinus should be freed from excessive granulation tissue or polyps, if such be present. If the mucous membrane of the sinus is not materially hypertrophied, it is probably better not to curette it, for thus we obtain a better chance for resolution after the lower obstruction is removed. However, if there

is much hypertrophy, ulceration, etc., the thickened portion should be curetted, but the periosteum of the lining of the sinus should not be removed. If distal portions of the sinus are already practically obliterated by dense scar tissue, do not disturb it.

The object of this minimum of curetting is to impair as little as possible the nutrition of the bony walls of the sinus and thus avoid subsequent necrosis. After a short time the sinus hemorrhage will be practically arrested and the vicinity of the ostium

FIG. 22.—Lateral skiagraphs. Lettering as in Fig. 21.

can be inspected. Almost all of the subsequent work is performed by the burr drills, introduced chiefly through the nose so that the burr is almost always in sight. These instruments are to be used just as a dentist reams our the carious portion of a tooth. No other instrument can be used for this purpose, because the part to be removed is otherwise inaccessible, and the use of chisels and rongeurs would be dangerous and inexact. The burr gnaws away the bone with precision and safety. At first the smaller burrs are introduced through the anterior areas to the region of

the guiding probe. First, the nasal crest is removed and the process continued anteriorly toward the nasal bone and nasal process at about their upper suture line. As the opening becomes larger the larger burrs can be used. By this means this portion of the nasal bone and the nasal process of the maxilla, together with the adjacent part of the frontal bone, becomes very thin and there remains only a bony shell around the circumference of the enlarged ostium. It is surprising how large an opening can thus be obtained. By means of the burr drill and a curette

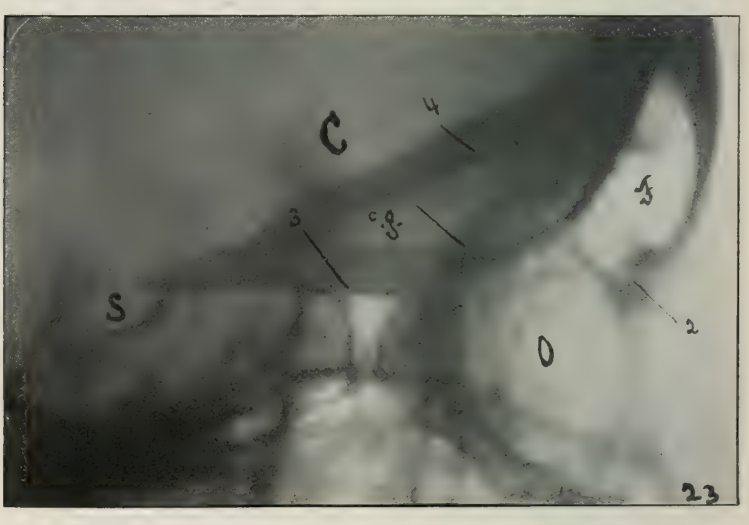


FIG. 23.—Lateral skiagraphs. Lettering as in Fig. 21.

the ethmoid cells, which may be present at the upper end of the infundibulum and opposite the lachrymal bone, and the agger nasi cell should be destroyed. While working opposite the lachrymal bone, the finger should be pressed gently in the inner canthus to serve as a guide and for protection. The lachrymal bone and the external surfaces of the ends of the nasal bone and nasal process should be not broken through, for these thin shells will serve to keep the region of the ostium from sinking in. This I believe to be the usual cause for failure in the

modern radical operation where this portion of the wall has been destroyed.

Recent cases operated upon have demonstrated the wisdom of making use of the combined nasal floor of both sinuses, even though only one sinus is pathologic, in the manner described below for operation in cases in which both sinuses are involved. The mucous membrane of the healthy sinus does not become

FIG. 24.—Lateral skiagraphs. Lettering as in Fig. 21.

diseased and the proximity of healthy mucous membrane favors early epidermization. Furthermore, the single opening in the facial wall gives ample opportunity for the complete operation, because we do not care to reach the distal portions of the normal sinus. A large part of the interfrontal septum is removed and, if desired, we could readily probe and curette the healthy sinus.

If both sinuses are involved, the opportunity for a large

opening is most excellent. The *x*-ray findings have already shown the topography of the sinus and, in particular, the distance between the crista galli region and the anterior contour of the sinus and also the extent of the interfrontal septum. The opposite sinus may be opened and its ostium enlarged in the manner

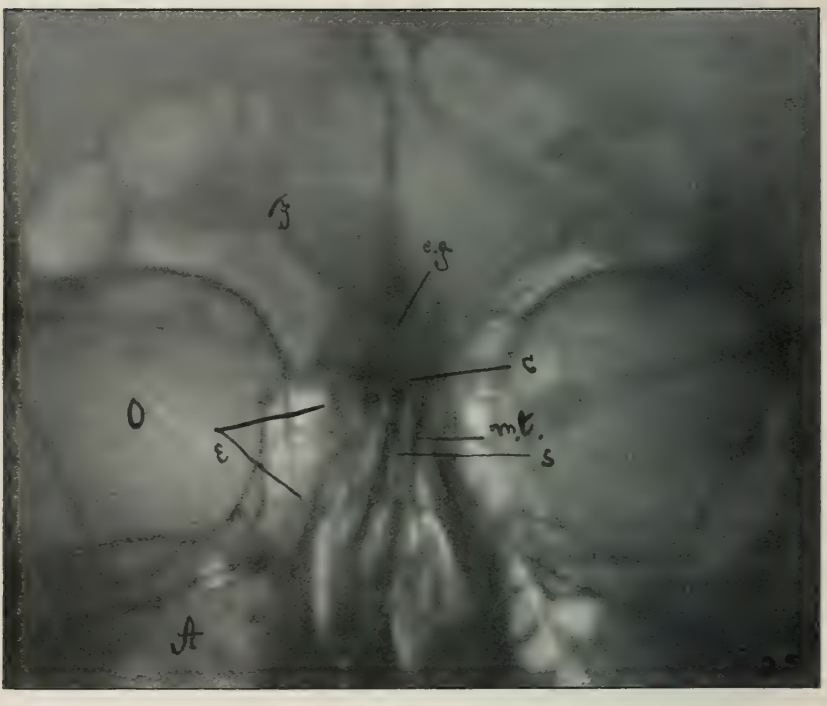


FIG. 25.—Anteroposterior skiagraphs. *F*, frontal sinus; *O*, orbit; *A*, antrum; *c.g.*, crista galli; *c*, cribriform plate; *s*, septum of nose; *m.t.*, upward projection of middle turbinate; *e*, ethmoid cells.

described above. Then this septum is perforated in its thin, central portion and its anterior and lower portion enlarged with the burr, gradually approaching the floor of the sinus. We are now at the base of the bridge of the nose, behind which is much dense bone in the vicinity of the median line where the septum of the sinuses and that of the nose meet. This can be removed

readily with the burr in view, leaving a thin protecting shell of bone in front. The portion of the septum of nose just below the sinuses should be removed also with the burr. This is made up of the perpendicular plate of the ethmoid and is to be removed for a depth of nearly one inch (Figs. 5 and 13). As in any sinus

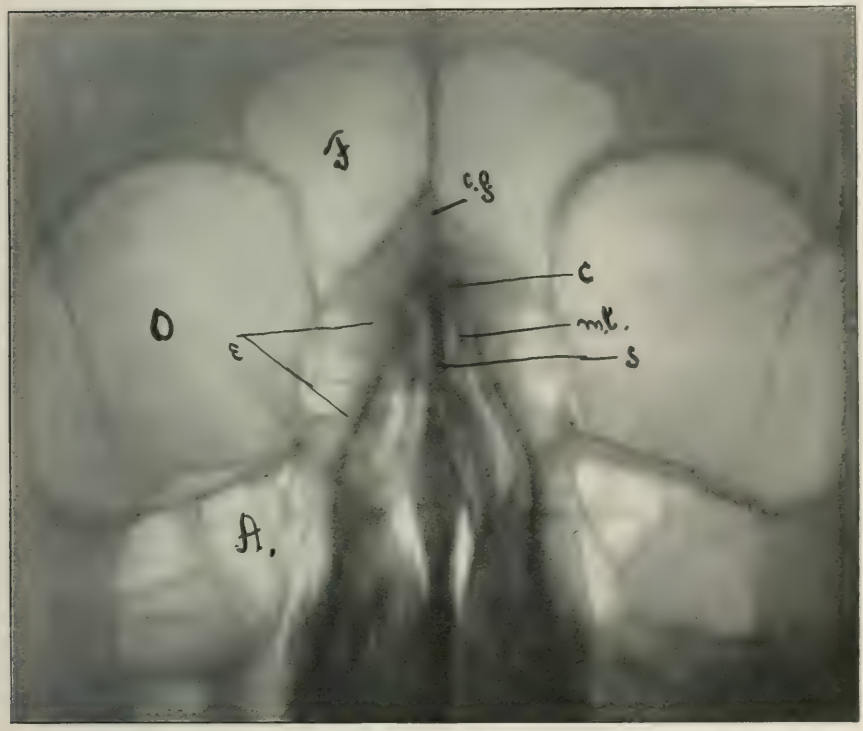


FIG. 26.—Anteroposterior skiagraphs. *F*, frontal sinus; *O*, orbit; *A* antrum; *c.g.*, crista galli; *c*, cribriform plate; *s*, septum of nose; *m.t.*, upward projection of middle turbinate; *e*, ethmoid cells.

operation, the posterior angle of the sinus and the region of the front end of the cribriform plate should be avoided at all times. It is surprising to observe in the average sinus how much space for drainage can thus be obtained. From below a comparatively large instrument can be swept across from one sinus to the other and from either nostril into either sinus. The removal of this

median partition adds so much more to the efficiency of the drainage that I believe it should be done even in cases where only one sinus is involved. It may, at first thought, seem an unwise step but I believe it will work for good and not harm in every instance. A sinus is opened frequently for exploration and generally without ill effect but, if any harm does follow, it is because of accumulated blood clot which cannot escape and which becomes infected. In these cases where the opposite side is opened, there is no chance for retention and the healthy mucous membrane does not become infected and pus is not retained. This is on the same principle that an antrum may act simply as a reservoir in frontal sinus suppuration and give no further trouble after the latter is cured. Furthermore, the chance for drainage is poor compared with that of the frontal sinus treated as above. Besides obtaining a very large opening, another advantage of connecting the sinuses is the fact that the mucous membrane of the healthy side allows epidermization in the vicinity of the new ostium on the diseased side. In skilled hands the whole operation can be accomplished through a single external opening, although a double opening is safer.

By the time the operation is completed the hemorrhage has practically ceased. With the head tipped forward, the external wound should be washed with a sterile solution and the skin incision closed. The tampons are to be removed from the nose and a compress bandage applied. The after-treatment is the same as in any case. Irrigation should be avoided for several days. As the intranasal areas begin to granulate around the ostium they should be kept clean and smooth by the usual methods. The whole sinus cavity is now particularly accessible for treatment.

The Closure of Fistulæ. Fistulæ are the result of obstruction at the ostium and may rise spontaneously or after operation. If the ostium becomes occluded during the course of an acute inflammation and remains so, an empyema or practically an abscess results, which in turn will cause a perforation of one of the walls of the sinus. An external fistula results if the perfor-

ation takes place through the facial or orbital wall: this tends to last indefinitely until corrected by operation. Following operation, where an attempt has been made to enlarge the ostium, a fistula may develop in the line of incision. This may appear after a few days, weeks or months, and is due to the fact that the opening has become obstructed, partly by edema and later by granulation tissue at the site of the ostium. These external fistulæ will remain closed only after a permanently patent ostium has been established by some means or other. It is fair to assume that this complication occurs in the obstinate cases which require more careful and radical treatment. Here again the operator must decide whether he will attempt to obliterate the sinus or establish a large ostium.

Epidermization of the Sinus. During the operation upon one of the obstinate cases, where an external fistula had existed in each sinus for over a year, Dr. O. A. Lothrop suggested the possibility of epidermizing the frontal sinus as is sometimes done after mastoid operations. I do not know that this has ever been attempted in the frontal sinus, but I felt that if the vicinity of the ostium could be protected with epithelium it would lessen the chance of granulation obstruction and the flap would serve as an island whence epithelium would tend to spread in all directions over the remaining sinus wall, as after the manner of any skin graft. This case was particularly obstinate because the supporting wall of the upper part of the lachrymal bone and nasal process had been removed by previous operators.

The following technic was devised and carried out and the parts have remained closed, an interval of twenty months having since elapsed. Just how much spread of epithelium has taken place it is impossible to determine. The sinuses were large and at the present time there is no discharge and the patient considers himself cured.

The steps were as follows, as illustrated in Fig. 20: After the vicinity of the ostium has been enlarged to as great an extent as the anatomy will allow, as described above, the edge of the skin of the upper lid is sutured to the periosteum on the outer

edge of the bony opening into the sinus with small catgut (Fig. 20, *b*); then an oval incision is made in the lid down to the muscle fibres, so as to form a flap about the size of the opening in the bone. The blood supply of the lid is excellent and the flap is very movable so that it turns readily without much cutting after division of the thin skin of the lid. The flap is now to be turned so as to cover the bony opening and is sutured to periosteum, preferably with fine chromicized catgut. Then the parts are washed carefully with a sterile solution and the remaining wound is closed. The lid is to be drawn across horizontally and it will be observed that there is very little tension and subsequent edema, and that the motion of the lid is not interfered with. In the two instances where the sinus was grafted, the scar is scarcely perceptible in one and in the other the depression is moderate and is due to the previous extensive destruction of bone.

This paper is designed to present general principles and a technic for operation. A list of cases operated upon is not included, as thereby nothing would be added to what has already been said.

REPORT OF A CASE OF COMMINUTED FRACTURE OF BOTH FEMURS: ONE TREATED BY PLATING, THE OTHER BY EXTENSION AND PLASTER-OF-PARIS CAST, WITH RADIOGRAPHS BEFORE, AFTER, AND SINCE RECOVERY

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AND
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ALBANY, NEW YORK

Mr. F. H. W., aged fifty years, a man of excellent habits and exceedingly good muscular development, was injured the morning of October 29, 1912. A horse attached to a heavy load of wet gravel stopped on a steep grade near Mr. W's. house, in the country, and began to back. Mr. W. hastened to assist the driver, and attempted to block the wheel. The wagon, cramped sharply at right angles to the road, plunged so quickly down a sharp, steep descent to the house that he did not have sufficient time to escape, and while in the act of jumping was struck squarely in both legs, about six inches above the knee, being held firmly fixed between the square end of the wagon and the house, with the load resting against his legs. He was only relieved when he directed the driver to cramp the wagon sharply in the opposite direction and drive down the hill. Mr. W., who was standing with his back to the house, fell on his back away from the building, and directly facing it. In doing so his legs became badly twisted. He soon discovered it was impossible for him to help himself in any way whatever. Dr. Stark, who

lived near by, was immediately summoned, and came to Mr. W's. relief in about twenty minutes. In attempting to straighten out his legs much suffering resulted, but it was soon evident

FIG. 1.—Left leg. *X*-ray taken October 29, 1912.

the soft parts had not been punctured, although plainly to be recognized there was a comminuted fracture of each femur. Mr. W. was placed in temporary splints, put on a stretcher,

taken a half-mile to the railway station, located in the baggage car, and brought to the Albany Hospital, a distance of about seventeen miles. Dr. A. Vander Veer saw him at the hospital

FIG. 2.—Right leg. *X*-ray taken October 29, 1912.

soon after his arrival. He was suffering from considerable shock, and great mental depression. In our consultation, after the first set of skiagraphs was taken (see Figs. 1 and 2) showing the

appearance of the two fractures, we determined it would be advisable—if his condition improved within a few hours—to

FIG. 3.—Left leg. Appearance of femur when dressing was removed, December 17, 1912.

reduce the fractures under an anesthetic. It will be observed that the left fracture is somewhat more comminuted than the right. Dr. E. A. Vander Veer arranged to plate the right femur, while

Dr. A. Vander Veer made use of the method employed for many years, of extension, reduction, and the application of a plaster-

FIG. 4.—Right leg. Appearance of femur when dressing was removed, December 17, 1912.

of-Paris cast for the left femur. This was done about four o'clock in the afternoon. The patient was under the anesthetic a little over two hours. Owing to his exhausted condition it

was not thought wise to take him to the *x*-ray room for other skiagraphs, but to remove him to his bed as quickly as possible. His case was one of some anxiety for the following twenty-four

FIG. 5.—Appearance of right femur, April 10, 1914.

hours, when he reacted nicely and made an excellent recovery. The wound made by the plating operation healed kindly and without any complication whatever. The plaster bandage be-

coming somewhat loose was removed from the left leg December 17, 1912, an *x*-ray picture taken (see Fig. 3) and limb found to be in excellent apposition. Fig. 4 shows appearance of right leg on

FIG. 6.—Appearance of left femur, April 10, 1914.

same date. By careful measurement, from the umbilicus, there was perhaps one-quarter inch shortening of the left femur. Plaster bandage reapplied to left leg, and a septic dressings, with bandage.

to right leg renewed. The patient was out of bed at the end of nine weeks, in a Morris chair, and encouraged to flex the knees and to begin the use of crutches, but this he found a very slow,

FIG. 7.—Side view of left femur.

painful process. There seemed to be a serious lack of confidence on his part in using the crutches; the fear of falling and not being able to bear much weight was very marked. February

25, 1913, plaster bandage removed from left leg, and there was evidence of good, firm union. Simple dressing applied, with bandage from the toes up, and the patient then began the use

FIG. 8.—Side view of right femur.

of crutches with more earnestness. In time he found that one limb would support him quite as well as the other, using the crutches for two or three weeks, then two, and finally one, cane.

The latter was given up in October, 1913, a year after the time of the accident. Since then he has walked very comfortably, with full confidence, and scarcely a perceptible limp, giving full

Fig. 9.

attention to his occupation as Chief of Inspections in the New York State Department of Education.

April 10, 1914 the *x*-ray pictures present fully the condition regarding the appearance of the right leg (see Fig. 5) and (Fig.

6) of the left. In the latter, it will be noticed, there is a decided bending at the point of union, yet the patient was able to walk with comfort.

FIG. 10

April 18, 1914 (Figs. 7 and 8), photographs were taken from a side view, showing one limb to be about as straight as the other, while an anterior view (Fig. 9) shows a decided bowing outward

of the left femur. Fig. 10, taken posteriorly, shows the bending even more markedly.

The last two *x*-ray pictures, together with the photographs of the left leg, I think demonstrate quite clearly that consolidation of the callus of the left leg has not been quite perfect, and that there has been a gradual giving way at the point of union, *i.e.*, a bending of the femur a long time after the patient was able to walk.

From this one case it is pretty positively shown that much better union was secured in the right femur, by means of plating, than by extension and use of plaster-of-Paris for the left leg.

Is it possible that the *x*-ray shadow gives an exaggerated expression of the deformity of the left femur? At the point of union in the right femur will be noticed a distinct separate enlargement, as though it might be the remains of the metal plate. On careful manipulation the patient has no pain nor can any sensation of a foreign substance be recognized.

THE SIGNIFICANCE OF THE THYMUS IN GRAVES' DISEASE: REPORT OF TWO CASES OF RESECTION OF THE THYMUS GLAND

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It was perhaps in 1849 that the first experimental proof was brought of the action which a ductless gland might exercise upon the organism. Berthold, professor in Göttingen, transplanted the testicles of young cocks and noted that the birds so treated developed the masculine voice, sexual desire, comb, and love of combat. He thus in considerable measure anticipated Brown Séquard, to whom the doctrine of internal secretions is generally accredited and who, twenty years after Berthold, committed himself to the view that a gland, whether possessed of ducts or not, elaborated substances which were essential to the growth and maintenance of the body and for the preservation of health. It was a memorable meeting of the Société de Biologie of Paris at which, two decades after his first pronouncement, this supergifted man related in support of his views the results of experiments made upon himself. He testified, as you recall, that following the injection of testicular juice he observed an astonishing revivification of his physical and mental powers.

One of the least understood and most complicated of the various, distinct, but intimately associated mechanisms at work in sustaining the orderly activity of the animal body is what has been termed the chemical correlation. Each organ, each tissue, and each cell of the organism may exert a chemical influence upon some other far-removed tissue of the body and

thus aid in bringing about the adaptations and readjustments essential for the integrity and life of the whole.

The acid chyme passing into the duodenum stimulates the epithelial cells of the mucosa to the production of a substance which by way of the blood-stream calls forth responses in pancreas, intestines, and liver, exciting the secretion of pancreatic and intestinal juices and of bile. Bayliss and Starling proposed the name hormones (ὁρμάω, to awaken, stir up) for such physiological products as serve to arouse the various organs to activity.

The structures which produce hormones are commonly called endocrine (κρίνειν, to separate) organs or glands of internal secretion.

Meltzer believes that, strictly speaking, such products of the chemical action of organs as must be regarded as terminal resultants of the decomposition processes, as the waste or by-products of metamorphosis, products which enter the circulation merely for the purpose of prompt elimination, should be differentiated from those substances which, formed in specific manner in individual or special organs, are taken up by the circulation and carried to distant parts, there to fulfil particular functions. Only these latter substances should, in the opinion of Meltzer, Gley, and others, properly be designated as hormones, and Gley has proposed the appellation parhormone for the decomposition products which invariably result from cellular activity and which as irritants might exercise a deleterious influence did not the fluids and tissues of the body form definite protective reactions.

Hormones can in two ways exercise their functions: either by direct action upon the tissues or by means of the nervous system. In addition to these relatively direct methods of manifesting their actions upon the terminal apparatus it is quite certain that the secretion of a given gland may act indirectly or through the agency of other hormonopoetic organs. For example, the influence of the thyroid by way of the thymus upon the activities of the stomach. To what extent the visceral nervous system plays a part and what may be the sequence of

events in the course of the complicated interaction of the endocrine glands may in a measure be determined by experimental studies in metabolism. Thus it has been ascertained that in animals the glycosuria which develops on administration of adrenalin vanishes after excision of the thyroids. If these animals are now fed with thyroid extract the glycosuria reappears. On the other hand, in the pancreatectomized animals excision of the thyroid does not cause the glycosuria to disappear.

Studies in metabolism have taught us that the thyroid and pancreas on the one hand and the pancreas and chromofine system on the other reciprocally inhibit. Between the thyroid and chromofine system, however, there exists a reciprocal potentiation. Hence when hyperthyroidism gives rise to glycosuria it may conceivably do so by inhibiting the pancreas. In a still more roundabout way the thymus *via* thyroid *via* pancreas might possibly bring about glycosuria unless, perhaps, the influence of the thymus might prove the adrenals were protective.

"Modern pharmacology regards as antagonists the sympathetic and autonomic[1] nervous systems. As the sympathetic system possesses in adrenalin a specific pharmacological stimulant so analogously the autonomic system has in pilocarpin and muscarin its specific irritants. One can by the administration of thyroid extract produce symptoms in animals and man which strikingly resemble the stimulating effects of pilocarpin or muscarin (sweating, diarrhea, disturbances in respiration, lymphocytosis, eosinophilia, etc.).

"The stand-point has accordingly been taken that in the thyroid there is a constituent which produces an effect similar to that of the poisons of the pilocarpin group. In favor of this view speaks, especially, the well-known antagonism between thyroid extracts and atropin, which is an antidote for pilocarpin and muscarin. It has now been attempted on the basis of these physiological facts, which indicate that from the thyroid gland impulses may be sent out along the tracts of the sympa-

[1] This word is used in the restricted sense and not as intended by Langley, who proposed the term *autonomic* for the entire sympathetic system.

thetic as well as the autonomic system, to distinguish the symptoms of Graves' disease which might be due to irritation of the sympathetic from those which might be attributed to autonomic stimulation." (Eppinger.)

SYMPATHETICOTONIC BASEDOW SYMPTOMS.

1. Pronounced protrusio bulbi.
2. Von Graefe, absent.
3. Löwi's phenomenon, positive.
4. Möbius, positive.
5. Dry bulbs.
6. Greatly increased activity of the heart with less pronounced subjective disturbances.
7. Sweating and diarrhea, absent.
8. Falling out of hair.
9. Eosinophilia, absent.
10. Inclination to fever.
11. Alimentary glycosuria.
12. Refractory behavior to pilocarpin.

VAGOTONIC SYMPTOMS.

1. Relatively moderate degree of tachycardia.
2. Pronounced subjective heart symptoms.
3. Von Graefe, definite.
4. Wide lid-clefts.
5. Möbius, absent.
6. Slight protrusio bulbi.
7. Increased lachrymation.
8. Profuse sweating.
9. Diarrhea.
10. Disturbances of digestion.
11. Eosinophilia, likely.
12. Alimentary glycosuria, absent.
13. No adrenalin-glycosuria.
14. Pigmentation.

There are certain exceptional more or less sharply differentiated cases of Graves' disease which every physician and surgeon who has actively interested himself in the subject must vividly recall. During the past twenty-three years in a series of about 500, I have seen perhaps 20 which were especially typical of their kind. The characteristic features which most of them presented were great emaciation, extreme dilatation of the heart, sweating, diarrhea, relatively slight exophthalmos, not excessive tachycardia, small goitre, and usually a peculiar grayish bronze-hued skin.

Confronted with a case of this kind I have repeatedly said to my assistants, "Here is another of these puzzling, dreadful cases." The patient is not highly thyrotoxic; the thyroid is hard, not large, nor pronouncedly vascular; if a lobectomy is performed she may die, but probably not with the stormy symptoms which suggest extreme thyroid intoxication. If death occurs it may be sudden, possibly not until several days after the operation, and perhaps when the patient seems to be convalescing.

In one of these cases death occurred four days after the ligation of a single artery under local anesthesia. The operation, including the injection of the local anesthetic and the sewing up of the tiny wound, required exactly ten minutes. One night, four days, as I have said, after the operation and a few minutes after the nurse had charted the pulse as 90, the patient awoke with a start, sat upright in bed, gasped for breath, and died. The following case died suddenly about thirty hours after a thyroid lobectomy when we had ceased to be apprehensive about her.

Case I.—A. V. C. (No. 33,010), aged forty-seven years. Admitted October 8, 1913. Except for whooping cough at the age of fifteen, mumps at nineteen, and measles at twenty-one years, the patient states that she has enjoyed good health until about four years ago.

In January, 1909, the patient experienced on swallowing the sensation of a "lump in her throat." At about the same time

she was seized with a severe headache, became very nervous, suffered from palpitation, and vomited several times. Thinks she had fever in this attack. Almost immediately the thyroid gland "began to swell." She was quite ill for three or four months, but in May of the same year felt as well as ever. Her recovery was so complete that she considered herself in normal health until January, 1913, when she was taken ill again quite suddenly with precisely the same symptoms as in the previous attack. Palpitation and shortness of breath were more pronounced than at first; diarrhea, vomiting, and difficulty in swallowing also became troublesome symptoms. Cessation of the menses occurred about that time. Since July 1, 1913, she has been confined to bed.

Examination. Patient is greatly emaciated (weight 67 pounds). Is very nervous, constantly jerking about and tossing her head; there is fine tremor of the fingers and tongue. Has decided mental aberration, ideas of persecution and grandeur. Has bad dreams. Talks to angels. Is confident that her mind is affected, etc. Has staring expression; is very nervous; the whole body seems to be shaken by the heart beat. The skin is ashy bronze in hue. Eyes: slight exophthalmos; definite von Graefe; convergence fair; rather wide palpebral clefts, but sclera covered. Joffroy sign absent; pupils react to light and accommodation. Hair: dry, gray, thin, and falling out. Thyroid uniformly and moderately enlarged and very firm. Faint bruit but no thrill over thyroid arteries. No palpable enlargement of any lymphatic glands. The carotids throb forcibly. Veins of neck pulsate. Thorax: great emaciation. Deep supraclavicular and subclavicular fossæ. Movements of respiration symmetrical. Lungs clear. Respiration, 28. Thymus: no definite retromanubrial dulness. *X*-ray negative. The heart is great dilated. There is a soft blowing systolic murmur over the whole cardiac area; it is heard best at apex. Pulse, 140 to 155 and over per minute, and irregular. Arteries not hardened; blood-pressure 115 to 125. Abdomen very scaphoid. Marked aortic pulsation. Edge of liver not palpable.

Blood. White corpuscles, 13,360; red corpuscles, 4,404,000; hemoglobin, 61 per cent.

October 13, 1913. *Differential Blood Count* (250 cells counted):

	Cells.	Percentage.	Actual number of each in c.mm.
Polymorphonuclear neutrophiles	128	51.2	6840
Small mononuclears	86	34.4	4595
Large mononuclears	21	8.4	1222
Transitionals	5	2.0	267
Eosinophiles	3	1.2	160
Basophiles	1	0.4	64
Unclassified	7	2.8	374
Myelocytes	2	0.8	106

October 20, 1913. Patient vomited frequently until five days ago. Has two to three or more watery stools a day. Has persistent cough.

October 21, 1913. *Operation I. Ligation of Left Inferior Thyroid Artery.* The artery was easily found and tied. It was as large as a vertebral artery. Patient's pulse rose to 200 and over during the operation under novocain, nitrous oxide gas, and a few drops of ether.

October 24, 1913. Patient remarkably improved since the operation. Restlessness greatly relieved. Vomiting has ceased. Pulse now averages only 100.

October 25, 1913. *Operation II. Gas. Ligation of Right Inferior Thyroid Artery.* Artery very large, very thin-walled, and blue like a vein. Operation required only a few minutes.

October 30, 1913. Patient has improved rapidly since second operation. Is quite cheerful. Hair regaining luster.

October 30, 1913. *Differential Blood Count* (250 cells counted). White blood cells, 8300.

	Cells.	Percentage.	Actual number of each in c.mm.
Polymorphonuclear neutrophiles	122	48.8	3984
Large mononuclears	37	14.8	121
Small mononuclears	69	27.6	2201
Transitionals	21	8.4	704
Eosinophiles	1	0.4	41

November 4, 1913. Marked improvement in patient's general condition. Pulse, 88. Patient eats heartily; neither vomiting nor nausea.

November 11, 1913. No pronounced change in patient's condition during the past week. Appetite large, but there has been no gain in weight (60 pounds).

November 16, 1913. Patient has gained $4\frac{3}{4}$ pounds in past five days.

November 24, 1913. No definite improvement during past week.

November 25, 1913. *Operation III. Right Lobectomy.* Gas and a few drops of ether. Operation simple and rapid. Patient's pulse rose only occasionally to 180, but was usually about 160 during the operation. At the first operation it rose to 200 and over. At the end of the operation the patient's condition was excellent.

	Cells.	Percentage.	Actual number of each in c.mm.
Polymorphonuclears	155	62.0	11,408.0
Small mononuclears	51	20.4	3,753.6
Large mononuclears	22	8.8	1,619.2
Transitionals	8	3.2	588.8
Eosinophiles	5	2.0	368.0
Basophiles	5	2.0	368.0
Unidentified	4	1.6	294.4

November 26, 1913. *Differential Blood Count* (250 cells counted). White blood cells, 18,400.

November 26, 1913. Patient had a fairly comfortable night and seemed to be convalescing satisfactorily until 1.20 P.M. today, when she was found sitting up cyanotic and gasping for breath. Pulse very irregular. Respirations 40 to 50. She was coughing, trying to clear her throat, and very excited and apprehensive. Area of precordial dulness markedly increased, extending 4 cm. to the right and 10 cm. to the left of the median line. At 1.50 P.M. she became quiet, seemed fairly comfortable, and dozed. Pulse, 140 to 180, and irregular in force and rhythm. Cyanosis less.

3.40 P.M. Suddenly seized with another dyspneic attack. Respirations became more labored, and at 4.05 P.M. ceased. The heart stopped beating about one minute before the cessation of respiration. The temperature rose to 101.5° F.

Autopsy. Subject strikingly emaciated (Dr. Reid). Left lobe of thyroid slightly enlarged; small slice of right lobe in the region of the parathyroids. Cardiac dilatation. Emphysema of both lungs; bronchopneumonia. Large thymus extending down to the auricles. Fatty degeneration and atrophy of liver; small adenoma of liver. Mesenteric glands rather larger than normal; otherwise no enlargement elsewhere of the lymphatic glands. Dilated, atrophic stomach. The thymus gland was thick but not broad enough to cast an *x*-ray shadow beyond the manubrium. It was triangular in shape, the finely tapered apex reaching to the top of the manubrium, the broad base extending to and partly covering the auricles of the heart.

The endocrine glands have been carefully studied microscopically and will probably be reported upon at other times by the various men to whom these organs were specially entrusted. I was particularly interested to find that in the thyroid glands the follicles instead of showing the usual picture found in exophthalmic goitre were for the most part circular and distended with densely staining colloid without vacuolation. The epithelial cells were low cuboidal or flat. In places, however, throughout the gland the colloid was rarefied and the cells high.

In this patient the vagotonic symptoms predominated (diarrhea, vomiting, small goitre, slight exophthalmos, definite von Graefe, Möbius not pronounced, intense subjective symptoms, pigmentation).

Was this a case of thymus death?

Physiologists, pharmacologists, pathologists, and clinicians are rapidly reflecting, consciously and unconsciously, helpful light for the interpretation of the clinical phenomena and dire results in cases belonging more or less definitely to this category.

In 1910 Meltzer[1] made the following cautious statement concerning the thymus gland: "With our present knowledge of the importance of the other ductless glands we are hardly justified in assuming that the thymus is a worthless fetal remnant. But we have to acknowledge that as yet there are no reliable observations or experiments which indicate clearly that the thymus has a function in post-uterine life."

About six months after this statement was made by Dr. Meltzer it was my good fortune to be present when Garrè, at the Fortieth Congress of the Deutsche Gesellschaft f. Chirurgie (1911) took part in the discussion of Kocher's paper on exophthalmic goitre in order to report the first instance in which the thymus had been primarily removed for the cure of this disease. Although well aware of the fact that a "persistent" or revived thymus had repeatedly been observed in "Basedow," he was astonished to learn from the statistics obtained by his assistant, Dr. Capelle, that a thymus persistens hyperplastica had been found in 95 per cent. of the fatal cases, whether death was due simply to the severity of the disease or occurred during the operation, or within twenty-four hours after the strumectomy.

So impressed was Garrè with these findings that he finally determined to test the effect of thymectomy in cases in which there was good reason to believe that the thymus was enlarged. It seemed to him that a severe and florid example of Basedow should be selected for the experiment, and that the thyroid gland should be unmolested in the operation the purpose of which was to determine the effect of a thymectomy upon the symptoms of the disease.

The result in his first case was as follows: Clinically no definite influence on the struma, the exophthalmos, or the eye symptoms, but an unequivocal improvement in the general condition as expressed by the "éclatant" quieting of the heart's action, rapid increase in weight, and a complete retrogression of the

[1] Animal Experimentation in Relation to Our Knowledge of Secretions, Especially Internal Secretions, Proc. Path. Soc. of Philadelphia, September, 1910.

Kocher blood-picture, the lymphocytes falling from 40 to 25 and then to 10 per cent.

In his second case Garrè performed simultaneously a hemistrumectomy and thymectomy.

The striking results which followed the first of these operations forced upon him the thought that the hyperplastic thymus in exophthalmic goitre displays an action essentially similar to that of the thyroid and that the thymus persistens aggravates the symptoms of the disease.

Professor Garrè gave to his assistant, Dr. Capelle, credit for the work and the thought which led them both to these conclusions, which he said finds essential support in the proof by Klose that in the thymus substance there is a heart poison. Aside from the special action of the thymus there exist certainly, said Garrè, important reciprocal relations between these two glands, and for the following reasons:

1. After thymus extirpation, the blood-picture, which by Kocher is considered characteristic of Graves' disease, returned to normal precisely as after a successful strumectomy.

2. His assistant, Dr. Bayer, had recently demonstrated that intraperitoneal injections of the expressed juices of the thyroid as well as of the thymus produce the Kocher blood-picture, whereas the juices of colloid struma and of normal thymus influence the blood-picture to a much less extent.

3. They found in a thyroid gland which had been removed six months after a thymectomy microscopic evidence of retrogressive changes.

4. Gebele had announced at the previous Congress that the prompt implantation of normal thymus in thyroidectomized dogs prevented the appearance of cachexia strumipriva.

5. He was able to state, thanks to the permission of Dr. Bircher, that the latter had twice produced the typical Basedow picture by the intraperitoneal implantation of the fresh, pathologically hyperplastic thymus. These and other facts made him unable to subscribe to the generally accepted view of Möbius that the thyroid is alone responsible for the disease.

On the other hand he was not prepared to take the extreme view of Hart that there was a purely thymogenic form of Basedow.

I have presented in such detail the views so briefly and cautiously expressed in 1911 by the highly gifted director of the surgical clinic in Bonn, because this contribution of Garrè and Capelle marks an epoch in the developing story of Graves' disease and its treatment, the importance of which is as yet not realized.

During the past three years the research work on the thymus, which already had been considerable, has assumed great proportions, and for surgeons interested in Graves' disease this gland has become a theme on which their attention may well be focused.

And now, just a few weeks ago, appears a most convincing paper by von Haberer, the youngest of Billroth's assistants, and, until his promotion to the directorship of the Innsbruck surgical clinic, first assistant to von Eiselsberg in Vienna, who is also a distinguished product of the school of Billroth. The results of thymectomy in von Haberer's case III, are so remarkable as to be almost unbelievable were they recounted by an authority not so eminent and trustworthy.

Case III.—Von Haberer,[1] merchant, aged thirty years. In his earlier years athletic; of late overworked in his business, but well until the autumn of 1909, when after an attack of fever he noticed a marked increase in the frequency of his pulse, loss of zeal for work, and a feeling of general bodily discomfort. About six months later he observed that his eyes were abnormally prominent, that he was becoming nervous and tremulous and subject to attacks of profuse sweating, and that he experienced feelings of cold in his legs. The greatly increased and irregular action of his heart caused him special uneasiness. In the spring of 1911 a part of the thyroid gland was removed, and thereafter, for a time, his symptoms, the tachycardia excepted, were somewhat relieved. In the winter of 1911, after

[1] Mitteilungen aus den Grenzgebieten der Med. u. Chir., Bd. xxvii, Heft 2, p. 210.

unusual business stress, the heart symptoms became greatly intensified and hemoptysis and dyspnea supervened. The dyspnea became so great that the patient was apprehensive at times lest he choke to death. He sought relief at the hands of Prof. Kocher, in Berne, who ligated the thyroid arteries of the unremoved lobe. No relief was obtained from the arterial ligation; on the contrary, the patient's condition became alarmingly worse. He frequently had attacks in which a bloody froth was expectorated and consciousness lost. He finally could not walk without provoking these attacks.

On December 7, 1912, the patient appeared at the clinic in Innsbruck of Prof. von Haberer. He was cyanotic, gasping for breath and covered with cold sweat; the pulse could not be felt in the peripheral arteries. Fearing that the man might die in his office, Prof. von Haberer had him hastily despatched to a sanatorium. After a short rest in bed, in a half-sitting posture (the only one endurable for the patient), the pulse returned at the wrist. It was 160, very irregular and unequal. Exophthalmos was particularly pronounced on the right side; skin and mucous membranes cyanosed; slight von Graefe and Möbius signs on both sides; tremor and great dyspnea; right lobe of the thyroid very slightly enlarged; left lobe not palpable. Over both lungs signs of edema and congestion-bronchitis; heart much enlarged, extending on the left side four finger-breadths outside of the mammary line. Liver greatly increased in size, its lower thick border extending as low as the navel. Slight but definite icterus. Compression of the trachea by the thymus was excluded both by percussion and the Röntgen ray. There was, however, behind the manubrium a triangular shadow which, without demarcation, blended with the shadow of the heart. Percussion revealed no unusual dulness.

The patient begged piteously for operation, indifferent to its dangers, desirous only to be relieved of his great distress. Prof. von Haberer refused to interfere surgically, being convinced that if an operation were undertaken at that time it would result fatally. The physician called in consultation

agreed that the patient's condition was hopeless, the heart being exhausted. The thyroid symptoms he regarded as a complication of relatively minor importance and believed that medication would accomplish nothing for the heart. The patient was kept in bed and treated with diuretin and digotoxin. In the course of ten days the condition of the lungs was somewhat improved, but the pulse, never dropping below 140, remained irregular, with frequent periods of galloping rhythm. The differential blood count gave polynuclears, 57 per cent.; small lymphocytes, 27.6 per cent.; large lymphocytes, mononuclears, and transitionals, 12.3 per cent.; eosinophiles, 2.9 per cent.; mast cells, 0.2 per cent.; coagulation was slightly delayed.

December 19, 1912. All were still agreed, and the patient assured that he could not survive an operation of any sort. Nevertheless, Prof. von Haberer, having in mind the somewhat analogous case of Garrè's, finally decided to yield to the patient's entreaties, and on December 19, under local anesthesia, succeeded after prolonged search, in extracting from behind the manubrium a piece of tissue 3 cm. long and 0.5 cm. thick, which resembled fat and macroscopically seemed to contain no thymus gland. Greatly disappointed at the result of the operation and believing that the last hope for the patient had vanished, Prof. von Haberer closed the wound about a drain. Toward evening of the same day the patient announced that he felt much better and that his dyspnea had disappeared. On the fourth day after the operation he became much worse, the pulse was feebler and more frequent; the liver increased in size and the icterus deepened. The following morning, however, and each day thereafter improvement was noted, and on January 3, 1913, two weeks after the operation, the patient was discharged from the hospital. Three months later (April, 1913) the patient returned for examination. The surgeons and physicians were astonished at the result. The apex beat was in the mammary line, the pulse 84, although still irregular; the cyanosis and icterus had disappeared; the liver was of normal size, and the color of the skin was good and fresh. The subjective condition was as

satisfactory as the objective. The patient declared that he felt perfectly well; he could work as tirelessly as ever and could even climb mountains. In September of the same year this patient wrote that he had climbed for sport a mountain over 7500 feet high.

Three primary thymectomies have been reported, all of them from Garrè's clinic. To these may, however, be added Sauerbruch's case, in which only the ligation of one superior thyroid artery preceded the operation on the thymus. In all of these cases the effect of the operation upon the general condition of the patient and upon the blood-picture was unequivocally beneficial. Of the combined operation, thyroidectomy plus thymectomy, 8 cases have been reported by von Haberer; and Capelle and Bayer state that several times in the clinic of Garrè this operation has been performed.

Klose states in his recent book on the thymus gland that he has in five cases of Basedow's disease resected the thymus. In each instance there was striking improvement in the patient's general condition and return of the blood-picture to the normal. I have excised a small portion of the thymus with one lobe of the thyroid in two cases of which I shall speak later.

It has been our practice of late in the strumectomy operations to investigate the contents of the space between the trachea and the manubrium, with the object of determining the possible presence of an enlarged thymus, and in a few instances we have opened the anterior mediastinum and made a fairly thorough search for this gland. Only twice have we found it enlarged; in both instances we should have been disappointed had there been no traces of thymus, and our faith in some of the most important strands of the complicated web which the pharmacologists, the physiologists, and the clinicians are weaving to represent the interdependent activities of the endocrine glands would have been shaken.

Case II.—H. P., aged thirteen years. Admitted to the hospital March 6, 1913.

Complains of difficulty in breathing, "feeling lazy," and

inability to work. During the past four or five years he has had attacks of vertigo, occasionally with loss of consciousness; also attacks of nausea and vomiting preceded usually by headache. Patient might remain in bed for a week after such attacks.

Patient believes that recent illness began two years ago. He noticed first a swelling in the neck which has gradually increased in size; then began to have a shortness of breath and the sensation of pressure on the trachea. He could not read aloud for any length of time. He could not run or ascend stairs quickly. During the past five months he has had dyspnea on lying down and has been unable to sleep on less than three pillows. Ambition for work and play is lost. He is unable to talk loud and finds it impossible to shout. Has a hoarse cough and desire to clear the throat. For the past four or five months he has experienced some difficulty in the swallowing of solid foods, and at times even of liquids; his bowels are evacuated four or five times a day. He has occasional attacks of vomiting before breakfast. Has become irritable. Has not observed palpitation of the heart. Does not perspire excessively.

Physical Examination. Boy is well nourished and well developed. The hair is oily; the skin neither abnormally dry nor abnormally moist. There is no exophthalmos; the von Graefe sign is positive at times; the other eye-signs are absent. The thyroid gland is enlarged to perhaps three or four times its normal size. There is definite rectomanubrial dulness. The *x*-ray shows suggestive shadow. A soft systolic bruit is heard over a very slightly enlarged heart. The pulse is regular, 80 beats per minute. Tremor absent. Cervical, inguinal, submaxillary, and axillary glands are palpable.

March 7, 1913. *Differential Blood Count* (300 cells counted):

	Cells.	Percentage.
Polymorphonuclear neutrophiles	160	53.3
Small mononuclears	102	34.0
Large mononuclears	23	7.6
Transitionals	8	2.7
Eosinophiles	3	1.0
Basophiles	2	0.7
Unclassified	2	0.7

March 18, 1913. *Operation. Excision of right lobe and isthmus of thyroid and a small piece of thymus.*

March 26, 1913. *Differential Blood Count:*

	Cells.	Percentage.
Polymorphonuclear neutrophiles	183	61.0
Small mononuclears	86	28.6
Large mononuclears	15	5.0
Transitionals	7	2.33
Eosinophiles	2	0.6+
Basophiles	2	0.6+
Unclassified	5	1.6

December 11, 1913 (nine months after operation). *Differential Blood Count:*

	Percentage.
Polymorphonuclears	68.0
Small mononuclears	23.0
Large mononuclears	5.0
Transitionals	3.0
Eosinophiles	1.0

February, 1914. *Examination.* The boy's health is almost restored. He is able to do a full day's work, but is rather more fatigued by it than are other boys of the same age. He can sleep on one pillow and has had no attacks of vertigo, nausea, or vomiting since the operation. The cough and difficulty in swallowing have disappeared. The diarrhea has ceased.

As the operation in this case was a combined one, the great improvement which followed it cannot definitely be attributed to resection of the gland alone. The portion of thymus resected was, however, so small that I am inclined to believe that the strumectomy rather than the thymectomy was chiefly responsible for the good result.

CASE III.—G. B. (No. 94086), aged twelve years. Admitted to the hospital February 12, 1914.

Has had most of the infectious diseases of childhood (whooping cough, measles, scarlet fever, chicken-pox, mumps), all before she was seven years old. Occasionally has sore throat, but has never had a definite attack of tonsillitis. Function of eyes and

ears normal. Has always been a nervous child with poor appetite. Digestion apparently good, although she has each year two or three "bilious attacks," with nausea and vomiting. For the past five years the mother has had difficulty in fitting the collars of her child's dresses, but not until a few months ago did she notice that the neck was enlarged. The eyes have always been prominent, protruding at times more than at others. For the past three or four years the child has complained of a feeling of fulness in the neck, especially when she was tired and nervous.

Examination. A rather pale, sallow-looking, frail girl. Expression alert and intelligent. She is unusually clever in conversation. Not obviously nervous at present. Hair normally lustrous. Hands and feet warm and rather moist. No pigmentation of skin. Dermatographia. No dilatation of superficial vessels of forehead or temples. Possibly slight fulness of veins of upper eyelids. Eyes decidedly prominent. Sclera well covered by lids. Palpebral clefts 1 cm. A suggestive stare. Von Graefe doubtful. No other eye signs. Pupils react to light and accommodation. Slight tremor of tongue, none of fingers. Pulse regular; 100 beats per minute. Accentuated throbbing of the carotids, particularly of the right carotid. Dilatation of superficial veins of neck on both sides. Neck enlarged, rather more so on the right than on the left side. Both lobes of thyroid palpable, the right more definitely than the left. The isthmus is prominent and measures 2.5 cm. vertically. There is neither bruit nor thrill in the gland. Circumference of the neck over the isthmus is 28 cm. The entire gland seems of normal or rather soft consistence. There is a suspicion of retromanubrial dulness. The *x*-ray reveals, however, no shadow suggestive of the thymus gland.

Tonsils markedly enlarged; crypts visible. Posterior cervical and axillary glands are palpable. Finger-tips are slightly clubbed. Child complains of palpitation of the heart and shortness of breath on exertion. States that on two or three occasions she has been obliged at night to sit upright in bed

to relieve a feeling of slight suffocation. Has usually two and sometimes three stools a day. Has never been constipated.

February 12, 1914. *Differential Blood Count.* White blood cells 7000. Hemoblogin, 92 per cent.

	Cells.	Percentage.
Polymorphonuclear neutrophiles	120	60.0
Small mononuclears	71	35.5
Large mononuclears	5	2.5
Transitionals	3	1.5
Eosinophiles	1	0.5

February 19, 1914. *Operation. Resected right lobe of thyroid and a small piece of thymus gland.* The right lobe of the thyroid, about two and one-half times the normal size, was resected according to our regular method, a portion of the posterior part being left to protect the parathyroids and the recurrent laryngeal nerve.

The thymus gland was found to extend upward almost to the inferior pole of the right lobe of the thyroid. The piece of the thymus resected was hardly larger than the child's little finger.

February 21, 1914 (two days after operation). *Differential Blood Count:*

	Cells.	Percentage.
Polymorphonuclear neutrophiles	154	77.0
Small mononuclears	25	12.5
Large mononuclears	11	5.5
Transitionals	10	5.0

It is interesting to note the fall in mononucleosis. Nine days before the operation the percentage of mononuclears was 38; two days after the operation it had fallen to 18 per cent. The child and mother are greatly pleased with the general improvement which they think has taken place since the operation. It is too soon for us to judge of this.

It is the belief of the few who have expressed an opinion on the subject that the over-activity of the thymus manifests itself chiefly or only after the hyperthyroidism has existed for some time—that it is not observed in the early stages of the disease.

In my patients II and III the thymus symptoms predomi-

nated (attacks of dyspnea, diarrhea, no tachycardia, not much enlargement of the thyroid, and not very definite eye symptoms).

So one cannot but feel that the hyperthymusism may have been primary in these cases and that later on the thyroid symptoms might have predominated. We shall try to follow carefully the subsequent history of these children; and as only a part of one lobe of the thyroid and a very small portion of the thymus of each child was removed we may not have influenced profoundly the natural development of the disease.

A case upon which a double thyroid lobectomy was done two years ago returned recently for examination. The thymus being still enlarged, it was treated for four hours by the emanations of 1300 mg. of radium applied over sixteen squares. Although there has been after ten days no reduction in the size or density of the *x*-ray shadow, two thyroid nodules as large as filberts, hypertrophied remnants of isthmus, entirely disappeared within twenty-four hours. Dr. Burnam, who applied the radium at Dr. Kelly's Sanatorium, believes that the thyroid nodules vanished because of the inhibited activity of the thymus. He thinks it is exceedingly unlikely that the emanations could have directly affected the thyroid.

The results of the combined operations have been, without exception, remarkably good; unmistakably better, I should say, than we ordinarily obtain from the operation upon the thyroid gland alone. Particularly striking has been the relative absence of the reaction which is usually observed in the thirty-six or forty-eight hours following thyroid lobectomy. The postoperative course in the experience of von Haberer could not be distinguished from that observed after operations for ordinary struma. This seems the more remarkable because in all these cases there was the complication of an enlarged and persistent thymus. The improvement was immediate and so strikingly pronounced that I agree with von Haberer in believing that it must be attributed to something more than mere accident.

That the thymus plays an important part in Graves' disease

has, I think, been demonstrated beyond question by the results which have followed thymectomy. That some sort of relation exists between the two organs we have further evidence from the physical examination of the non-fatal cases, from the autopsy table, and from experiments on animals. Palpation just above the manubrium, particularly pressure downward toward the mediastinum, and over-extension of the head may be complained of by patients with persistent thymus on account of the shortness of breath occasioned by these maneuvers.

The Röntgen ray and the percussion note over the area occupied by the thymus may give useful information; but the absence of both dulness and shadow does not exclude the presence of a persistent gland, nor do we know as yet how small a thymus may be responsible for symptoms.

It has been estimated as a result of non-operative clinical examination that in about 40 per cent. of all cases of exophthalmic goitre the thymus is persistent. The actual percentage it remains possibly for the surgeon to determine by systematic exploration. We have, I think, no absolute evidence that the thymus may be completely wanting in a case of Graves' disease; and since, as I have stated, we do not know how small a fragment of this gland may suffice to play a part in the disease, we are not as yet in a position to assert that exophthalmic goitre may exist entirely uninfluenced by the thymus. Von Haberer, however, reports an outspoken case in which careful operative search failed to reveal its presence.

Enlarged thymus not infrequently accompanies colloid goitre. Attention was called by Astley Cooper and by Virchow to this association. The question naturally suggests itself. Has the persistent thymus the same significance in both these forms of goitre, one of which we hold accountable for symptoms of hyperthyroidism, whereas with the other the picture of underactivity of the thyroid is associated? Is it not conceivable that the persistent thymus in colloid goitre may in some cases represent responses from time to time to periods of perhaps overlooked hyperfunction of the thyroid, and if so that indeed

for the "Kropfherz," a contributing factor may be found in the thymus?

From the postmortem examination of cases of exophthalmic goitre which have died of intercurrent disease it has been ascertained that the thymus gland is persistent in about 82 per cent. of them; and in those cases which have died of heart failure after operation enlargement has been found, as already stated, in about 95 per cent. Probably it will be ascertained that the percentage has been underestimated for the reason that enlargement of the thymus may not hitherto have been so completely noted or looked for as it will be in the future. Then, too, we must bear in mind the important lesson taught us from von Haberer's Case III, that the severest thymotoxic symptoms may be caused by fragments of thymus so small as to be unrecognizable as such by the naked eye.

At the Johns Hopkins Hospital there has been only one opportunity to make an autopsy on a case of Graves' disease which died after operation. In this instance, as I have mentioned, a long, thick thymus gland was found tapering out from near the top of the manubrium sterni to the auricles of the heart.

What are the particular symptoms of Graves' disease which indicate a preponderate influence of the thymus? Eppinger, Garrè, von Haberer, Klose, Capelle, Bayer, van Noorden, Jr., and indeed almost every clinician who has familiarized himself with the literature would say it is the vagotonic symptoms. But do we know quite definitely what the vagotonic symptoms are? And in case they should be determined, shall we be in a position to assert that the thymus is or is not alone responsible for them?

Naturally it will fall to the lot of the surgeon to discover which of the symptoms are dissipated by the removal of the thymus; but even when this has been ascertained the proof is not furnished that no other organ could have had a part directly or indirectly in their causation.

Let us consider, for example, the protrusion of the eyeball, a symptom which according to MacCallum and others may be

caused by stimulation of the sympathetic. If it is true that this is a sympathicotonic symptom, and if the thymus were activated solely by the autonomic system, the excision of this gland might not be expected to affect directly and promptly the exophthalmos. But as a matter of fact, recession of the eyeball in at least one of von Haberer's cases was much more prompt than has perhaps ever been observed after strumectomy alone. The effect on the thyroid gland, particularly as to its vascularity, seems to have been quite as striking in von Haberer's experience; it must, however, be remembered that except in one case the combined operation was performed.

To discuss the grounds on which the various signs have been assigned to their special groups would carry us beyond the purpose of this paper. I might say, however, by way of illustration, a word with reference to the incomplete convergence of the eyes. This, the Möbius sign, is assigned to the sympathicotonic group. It was explained by the late Dr. Landström and his supporters as due to the contraction of the Müller-Landström muscle of the orbit which is supposed to be responsible for the protrusion of the eyeball and by the particular arrangement of its fibers to embarrass the action of the internal rectus. There are some, and especially certain countrymen of Landström, who do not consider the demonstration complete that the Müller-Landström muscle is responsible for the exophthalmos. Furthermore, as I have said, the eyeball may promptly recede after thymectomy, and with its recession the Möbius sign may vanish, which is contrary to what might have been expected of a sympathicotonic symptom after the excision of an organ activated chiefly by the autonomic or vagosympathetic system.

Surgeons the world over have learned from an experience which is now very large that the majority of patients afflicted with exophthalmic goitre may be relieved of their symptoms by strumectomy, but that in a certain percentage of the cases the cure may be incomplete even after resection of the greater part of both lobes of the thyroid gland (Halsted).

RESULTS OF OPERATIONS FOR BASEDOW'S DISEASE [1]

Year.	Authors.	Number of cases.	Per cent. of cures.	Per cent. of considerable improvement.	Per cent. of slight improvement.	Per cent. of no improvement.	Per cent. of deaths.
1896	Schulz	20	90.0	....	....	5.0	5.0
1898	Wolf	9	....	66.5	....	....	22.5
	Helferich	6	66.6	16.7			
1900	Reinbach (Mat. of v. Mikulicz)	18	66.5	22.5	....	5.5	5.5
1902	Witmer (Mat. of Krönlein)	23	40.9	36.2	9.2	9.2	9.2
	Th. Kocher	59	76.0	14.0	....	3.3	6.7
1903	Curtis	11	60.0	10.0	....	....	30.0
1904	Mayo	40	67.5	17.5	....	....	15.0
1905	Lessing (Mat. of König)	8	50.2	....	37.3	....	12.5
	Hartley	21	87.5	....	....	....	12.5
1906	K. Schulze (Mat. of Riedel)	50	72.0	12.0	....	2.0	14.0
	A. Kocher	167	93.7	....	....	....	6.3
1907	Itzina (Mat. of Hildebrand)	7	85.7	....	....	14.3	
	Mayo (only new cases)	136	78.2	19.6	....	....	2.2
	Halsted	90	97.8	....	....	....	2.2
	Landström	54	50.2	15.3	....	29.0	5.5
1908	Moses (Mat. of Garr.)	28	16.9	41.6	24.9	12 5	4.1
	Klemm	32	93.2	....	3.4	3.4	
	Th. Kocher	153	....	98.7	....	....	1.3
	MacCosh	22	14.5	72.7	8.2	4.6	4.6
1909	Hänel	21	38.1	42.8			
1911	Sudeck	26	84.6	4.0	....	....	4.0
	Baruch	40	72.5	12.5	....	15.0	15.8
	v. Eiselsberg	44	61.4	34.1	....	4.0	
	Enderlen	40	70.0	20.0	....	2.2	2.2
1912	Klose	61	75.5	9.8	....	1.6	13.1
	Weispfennig	30	60.0	6.6	....	23.3	10.0
		1216	61.8	21.2	3.1	5.0	7.6

Total = 86.1

I have performed perhaps 650 operations upon about 500 patients with Graves' disease. A one-sided lobectomy, the operation ordinarily done, has resulted in an approximate cure in possibly 60 per cent. of my cases, but in at least 25 per cent. the patient has not been sufficiently relieved by a one-

[1] Klose, Die Basedowsche Krankheit, Ergeb. d. inn. Med. u. Kinderheilk, 1913, Bd. x.

sided lobectomy to resume her full duties, and in certainly more than 50 per cent. (possibly 70 per cent.) there remain symptoms of overactivity of the thyroid or thymus or of both of these glands sufficiently pronounced to be detected by the expert clinician.

The results of my experience as regards the cure of Graves' disease by one-sided lobectomy are quite at variance with the views of other surgeons.

In some 47 cases in which the improvement was altogether unsatisfactory after the excision of one lobe, the other was removed. Of particular interest to me has been the observation, which we have made several times, that definite improvement may not be observed until both lobes have been almost completely excised. In a number of cases—all of them severe—in which the preliminary ligation of three or four arteries plus a single lobectomy was followed by little or perhaps inappreciable benefit, the symptoms vanished, almost magically, on the removal of the remaining lobe. I should explain, parenthetically, that I never excise the entire lobe; a small slice is always left posteriorly to protect the parathyroid glands, for the reason that the chances are considerable that the other side may have to be operated upon. It is undoubtedly because surgeons have so universally confined their operations to the excision of one lobe plus, perhaps, the ligation of an artery of the other, that the results have not been better than they are. And you will agree with me that it is rather absurd to conclude that if the excision of an arbitrary amount of a gland supposed to be chiefly responsible for the symptoms did not cure or relieve them it would be useless to remove more of the offending organ.

Now although all of the symptoms including the exophthalmos may be cured by strumectomy, the blood-picture may remain unchanged, at least for a considerable period. We have, for example, five cases in our wards at present whose mononucleosis is as great and in one of them greater than before operation. In one the four arteries have been tied and one lobe resected.

In two both lobes have been excised, and in the fourth, a very serious case, the inferior arteries were first ligated, then the superior arteries; next the right lobe and then the left was resected. This patient's health has already been almost completely restored, but the mononucleosis is 53 per cent. (small mononuclears 34 per cent., large mononuclears 19 per cent.), 4 per cent. higher than on admission.[1]

Baruch, Sudeck, Klose, Melchoir, Lampé, and Liesegang, and others seem to have brought proof from extensive clinical observations that the pathological blood changes in Basedow's disease remain uninfluenced by the excision of the thyroid gland.

Klose states that it is universally conceded that all the symptoms of Graves' disease may disappear after thyroidectomy, but that the disordered blood-picture is supposed to remain unchanged, and hence if we desire a hematological cure we must attack, surgically, the thymus. Another particular indication, according to Klose, for the excision or destruction of the thymus is the fact that in Graves' disease this gland is qualitatively and not merely quantitatively altered, and may cause toxic as well as mechanical injury to the heart.

Borchardt a little more than a year ago reported[2] the result of his studies in the medical clinic of Lichtheim at Königsberg of the blood-picture in diseases of the endocrine glands. He examined 31 cases of Graves' disease, 10 of status thymico-lymphaticus, 5 of simple goitre, 15 of myxedema (2 of his own and 13 in the literature), 13 of disease of the hypophysis (3 of his own and 10 in the literature), and 5 of Addison's disease (2 of his own and 3 in the literature).

Borhardt found that in all diseases of the glands of internal secretion there was in the great majority of the cases an increase

[1] These and many other cases controvert the opinion of von Lier who regards a lymphocytosis of 40 per cent. as a contra-indication to operation.

[2] Ueber das Blutbild bei Erkrankungen der Drüsen mit Innerer Secretion und seine Beziehungen zum Status thymico-lymphaticus, Deutsch. Archiv. f. klin. Med., 1912, Bd. cvi.

in the mononuclear cells, especially of the lymphocytes. There was leukopenia in about half of the cases, and approximately as often eosinophilia.

Since in all diseases of the thyroid, hypophysis and adrenals signs of status thymicolymphaticus were established, he concludes that the changes in the blood-picture are to be assigned to a status lymphaticus. My observations do not permit me to accept *in toto* the views of Klose, Borchardt, and the many others who attribute the lymphocytosis to the thymus. Of the forty-seven or more cases above referred to, operated upon during the past twenty years, in which I found it necessary to remove both lobes of the thyroid gland in order to relieve sufficiently the symptoms, about one-half have returned within the past two years for examination. In all of these, with perhaps two or three exceptions, the blood-picture is approximately normal. Of particular interest are the findings in a case at present in the hospital, operated upon two years ago (double thyroid lobectomy). She was so ill when first admitted to the hospital that I debated for some days as to the advisability of performing a lobectomy without the preliminary ligation of arteries. Her symptoms were predominantly vagotonic; furthermore, she had an enlarged thymus, as revealed by percussion and the *x*-ray, and a *mononucleosis of* 53 *per cent.*

The improvement which followed the resection of one lobe being unsatisfactory, the remaining lobe was excised. The blood-picture was at the time only slightly altered by these operations, although there was marked improvement in her general condition.

Now, after two years, she has returned to the hospital for examination. She is almost restored to health, and is able to perform all of her laborious household duties. She complains particularly of a sense of pressure behind the manubrium, to which she attributes in a measure her shortness of breath at times. Percussion and the *x*-ray indicate definitely an enlarged thymus. *The blood-picture is, however, normal* (mononucleosis, 30 per cent.).

Another patient (Miss G. C.) has just come on for reëxamination from Texas in response to a telegram from me. A year ago, when admitted to Dr. Barker's service in the hospital she was acutely and desperately ill, and was promptly transferred to the surgical side. The thyroid arteries were ligated, two at a time, and then, one after the other, the thyroid lobes were resected. Vagotonic and sympatheticotonic symptoms were about equally pronounced. There was extreme exophthalmos with all of the eye signs. Pulse 140 to 150; slight enlargement of the heart. Sweating, diarrhea, nausea and vomiting, intestinal gas, bad dreams; dyspnea, vertigo, and very severe muscular cramps. *Mononucleosis* 51 *per cent.* There was no evidence of thyroid enlargement.

Now, after a year, she has gained greatly in weight, is, in fact, a little too fleshy. Her general health is fairly good and is gradually improving. But her condition is not satisfactory. Her pulse is 100 to 110, she suffers from dyspnea on slight exertion, has very little energy, and is greatly concerned about the exophthalmos which is still a conspicuous disfigurement. *The blood-picture is, however, normal* (*mononuclears* 28 *per cent.*).

From the facts gleaned at the autopsy table, from experiments on animals, and above, all, from the results following primary thymectomies, we have convincing evidence that the thymus gland may play an important part in Graves' disease and in some cases assume the title rôle. Some of the most puzzling features of the disease are made possible of interpretation by the discovery of the influence which the thymus may exert.

That the secretions of the two organs concerned in the production of the Basedow picture have a relationship there can be little doubt. The injections and implantations in animals made by Svehle, Bircher, Bayer, Basch, and Gebele demonstrate conclusively that the thymus and thyroid possess in common certain fundamental physiological properties.

Antagonistic factors are also at work in the two glands, the

presence of which is indicated sometimes directly and sometimes indirectly by the behavior of other organs. There are few who are not familiar with the already famous experiments of Gudernatsch. To tadpoles equally developed he fed to some the thymus of the calf, to others the thyroid of beeves. As a result of the thymus feeding the tadpoles increased greatly in size without differentiation or change in form. The creatures fed with thyroid promptly put forth arms and legs and otherwise rapidly took on the features of the frog. In the relation of the thymus and thyroid to the genital sphere and to the adrenals we find indications of a possible antagonism of some sort between the two glands. It is a well-attested fact that gravidity exercises a favorable influence upon the symptoms of Graves' disease. Basedow himself made this observation. This would seem to indicate that in pregnancy, in which unusual demands are made upon the thyroid, an excessive secretion from this gland can be utilized.

Between the thymus and ovaries there is experimental evidence of a possible functional antagonism. Thus Paton, Soli, Klose, Vogt and others have observed after thymectomy an increase in the weight of the ovaries, and according to Tandler and Gross there is abnormal persistence of the thymus in eunuchs.

Eppinger[1] relates of a case of Graves' disease of mild form that immediately after castration toxic symptoms of threatening severity set in. He states that in the literature (reference not given) he has found a similar case. Of like significance probably is the fact that during the climacterium a mild form may be converted into a severe form of Graves' disease.

Four or five years ago I was consulted in the North Carolina Mountains, thirty-five miles from the railroad, by a native woman (Mrs. B.), who stated that for the previous six months she had been able to swallow nothing but liquids and for a week or more nothing but water. She was greatly emaciated

[1] Die Basedowsche Krankheit, Handbuch d. Neurologie, Bd. iv, specielle Neurologie, iii, 62.

and so weak that she could barely stand. She was confident that the obstruction was just behind the "Adam's apple." The thyroid and cricoid cartilages were strikingly prominent, so much so that I confidently expected to feel a carcinomatous mass back of the larynx. I could feel nothing, however, except possibly an indefinite soft mass of the presence of which I was not absolutely certain. She refused to come to the hospital, saying that she preferred to die at home. A year later I was surprised to find her robust and in perfect health. The difficulty in swallowing began to diminish soon after her visit to me, and in a month or two she was able to take food of all kinds and sizes as well as ever. The relief seemed to come promptly after the complete cessation of the menses. I concluded that a retrotracheal or retro-esophageal portion of thyroid had become enlarged during the climacterium.

As further evidence of an antagonism between the secretions of the ovaries and thymus we may mention the excessive lymphocytosis which has been observed by Klose to follow the injection of Basedow-thymus after oöphorectomy. Klose injected 5 c.c. of thymus juice expressed from the gland of a Basedow patient into a spayed bitch whose lymphocytes after castration had risen to 32 per cent. Immediately after the injection there developed symptoms of severe Basedow intoxication. Shortly before death, which occurred one hour after the injection, the lymphocyte percentage was 64.

In one of my dogs (No. 9) which for sixteen months had been deprived of both thyroid lobes and all the parathyroids except a graft, Dr. MacCallum found complete absence of spermatogenesis. The testis as a whole was atrophic and spongy, but the interstitial cells of Leydig, although inconspicuous and perhaps somewhat degenerated, were still present in abundance.

What, then, is the relation of the thymus to the thyroid in Graves' disease? As stated by Capelle the thymus can hardly be an "Erfolgsorgan" (a terminal apparatus), which enlarges simply in response to a stimulus from the specific gland. It

is not merely antagonistic or compensatory (loose terms) to the thyroid, for if so its excision should be attended with an increase of the Basedow symptoms. These organs have, however, some sort of reciprocal relation. The effect of excision of the thyroid upon the thymus and of the latter upon the former organ has not been definitely determined.

In the dog (No. 9) just referred to, in which both of the thyroid lobes and all of the parathyroids had been excised, the thymus was carefully examined by Dr. MacCallum, who at that time could have had no knowledge of its possible importance in Graves' disease. His report is as follows:

"There is quite abundant thymus tissue. In the thymus there are some cysts, one of them quite large and lined by ciliated epithelium. Ciliated cavities of small size are found quite frequently through the tissue. I do not see any Hassall's bodies unless these might represent them. The thymus is not in the acme of its development, but has undergone a certain amount of atrophy."

Tatum found that the thymus of rabbits atrophies after excision of the thyroid.

As to the effect upon the thyroid of total excision of the thymus there is also uncertainty. The histological picture presented by the thyroid, seven months after total excision by Dr. McClure of my staff, and Dr. Park, Dr. Howland's assistant, of the thymus in a puppy, aged three months, seems to be identical with that obtained by Matti and Klose, and interpreted by them as hyperplasia. On comparing the sections of the thyroids of Dr. McClure's dogs, of the control with that of the thymectomized animal, I should say that the changes in the latter indicate overactivity. These changes consist chiefly in the entire disappearance of the colloid, and great increase in the height of the cells. The follicles are perhaps a little smaller in the hyperactive gland than in the control, and involutions are not conspicuous.

One can hardly be too cautious in assigning causes for the appearances found in one gland after excision of another or in

the remains of a gland after the resection of a part of the same. I am prompted to say this from experiences of my own, having particularly in mind our efforts to find the cause of the almost invariable hypertrophy of the thyroid in our dogs experimented upon twenty-six years ago, and to explain its absence after identically the same experiments during the past two years.

The pigmentation which has so emphatically arrested our attention in certain cases of Graves' disease deserves, I think, greater consideration than it has hitherto been accorded.

Our interest in this symptom has vastly increased now that we believe that the thymus may be an important factor in the disease.

As to the frequency of the occurrence of abnormal discoloration of the skin, the statements of the various authors do not agree. Sattler, who gives the matter full consideration in his classical work on the symptomatology of Graves' disease, places it at 18 per cent. Kocher finds abnormal pigmentation of the skin once in 8 cases; Friedrich Müller observed it in 4 out of 5 of the serious cases; Murray noticed a more or less pronounced pigmentation of the skin 42 times in a series of 180 cases. There are some who think that this symptom rarely occurs. I have observed it chiefly in the instances of severe and of long-standing disease, and on reviewing the histories of my patients am impressed with the fact, as it seems to me, that the pigmentation has been more frequent in the vagotonic type of the disease.

This observation accords with what might be expected from animal experimentation and from the relation which has been observed by pathologists and clinicians of the thymus to the adrenals in status thymicolymphaticus and in Addison's disease. Dr. Samuel J. Crowe of our staff, finds as a result of careful search of the records of the pathological department of the Johns Hopkins Hospital, that in all the cases of status thymicolymphaticus there is a note to the effect that the adrenals were atrophied and that in Addison's disease hypertrophy of the thymus is almost invariably recorded.

Boignet and Calogero and Matzoukis found that excision of the adrenals was followed by hypertrophy of the thymus. Soli, Matti and, I think, Klose noted enlargement of the adrenals after thymectomy. Wastenson states that involution of the thymus may occur in consequence of the injection of the extract of the medulla and cortex of the adrenals. Possibly the extract of the medulla alone might have produced similar results, for Matti states that it is the medullary portion of the adrenals which hypertrophies in dogs deprived of the thymus gland.

Matti found, further, in his own laboratory an indirect confirmation of the above-mentioned experimental data in that two animals with strikingly pronounced thymus hyperplasia following extirpation of the spleen showed an extraordinary diminution in the amount of adrenal medulla. In this constant reaction between the thymus and adrenal glands depressor influences are espied.

Treatment. Primary thymectomies uncomplicated by strumectomy, and secondary thymectomies in cases not sufficiently relieved by resection of both lobes of the thyroid would be the operations of choice for those searching for the essence of the Basedow thymus. The combined operation would be avoided by them as much as possible until it became more definitely known how profoundly and in what particulars the thymus may influence the disease. The excision of even a very small piece of either gland for microscopical examination, in the course of operation upon the other, might vitiate the experiment. For example, in our Case II (boy, aged thirteen years), the resection of a portion of thymus hardly larger than one's thumb was followed by almost complete relief of the symptoms, including a return of the blood-picture to normal, a symptom which we believed to be thymo- rather than thyrotoxic.

We are debating what should be done in a case desperately ill in which there are reasons for believing that the thymus is enlarged. Should we first ligate the thyroid arteries at one or more operations or perform primarily a thymectomy? The ligation of one and perhaps even of two arteries is less of a

proceeding than the excision or resection of the thymus, but is it not possible that the removal of a part of the gland the more specifically responsible for the disease might be better withstood by the patient than an operation of less magnitude upon the other? In our Case I, for example, the ligations of the inferior thyroid arteries were followed by very little reaction, and by great improvement in the general condition of the patient. Would it not have been better, we are asking ourselves, to have performed a thymectomy either primarily in this case, or in preference to the thyroid lobectomy which was done subsequent to the ligations? The patient, you will recall, died suddenly one day after the strumectomy. These are questions to which further experience must give the answer.

I may say that except in the instance reported (Case I) we have had no death from a lobectomy which had been preceded by preliminary ligation of one or more of the thyroid arteries. And even in the case just cited I am inclined to think that death might not have occurred had I ligated the superior as well as the inferior vessels. I believe from my own experience that, disregarding for the moment the question of thymus resection, we have absolute proof of the advisability of ligating the thyroid arteries, as advised by Kocher, in the severest forms of Graves' disease, indeed in all cases where there seems to be the slightest ground for fear that the patient might not withstand lobectomy. Most surgeons have abandoned or not practiced preliminary ligation of the arteries, contending that the repeated operations are more troublesome to the surgeon, are unpopular with the patient, and yield no better results. As to the last point, I am sure they are mistaken; as to the weight to be attached to the other two, each must be his own judge.

From the point of view of the research worker the combined operation, thyroidectomy plus thymectomy, should, as I have said, not be done, but when having excised one lobe of the thyroid I find myself actually confronted at the operating table with an enlarged thymus, I feel compelled for the patient's sake to resect it.

There is much reason for hope that radium and the Röntgen ray may give us the solution of this question. The blood of Basedow patients who have been treated with the *x*-ray shows remarkably little mononucleosis (Klose). Klose, Arella, Heineke, Peters, and others have shown that under the influence of the *x*-ray the thymus rapidly undergoes involution, an involution which is so extensive that Klose expressly warns against radiation of the thymus region in children. The relative absence of lymphocytosis in Basedow patients whose goitres have been treated with the *x*-ray is attributed by Klose to the influence of the rays upon the thymus. In a case referred to earlier in the paper it was mentioned that two nodules, remains of the isthmus, vanished promptly after prolonged exposure of the thymus to 1300 mg. of radium. The gradual enlargement of these nodules had caused the patient great anxiety, and she was the first to notice that they had disappeared. Furthermore, she no longer experienced the feeling of oppression behind the sternum which had been a source of constant annoyance and occasionally of distress.

I have touched my subject only very lightly at some of the higher points. Hardly enough has been said even to make it clear that an enormous amount of work underlies the facts which we at present possess. It must be evident to everyone, however, that there reigns the greatest confusion on the subject of the function of the glands of internal secretion.

Fortunately, the ardor for research on our globe in not diminished by the conviction that we are laboring in the wake of workers infinite in numbers on countless worlds who have carried their investigations millions of years beyond the stage reached by us, and are rapidly progressing toward an ultimate solution which may never be reached.

CHRONIC PANCREATITIS

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AND
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As a direct object of surgical attack the pancreas remains today the most unpromising of all essential organs. Complete removal is homicidal, partial excision is difficult and but rarely indicated by the character of its diseases, and direct drainage can be accomplished only in very imperfect fashion at best. In the past few years much has been added to our knowledge of pancreatic disease, its frequency and its pathogenesis. As surgeons we should derive some therapeutic gain. It is in the hope of clarifying our position in respect to chronic pancreatitis that we offer these brief observations.

Our difficulties in dealing with chronic pancreatitis are greatly increased by the fact that we possess no definite syndrome of signs, symptoms or laboratory tests by which an early clinical diagnosis can be made, and the situation is further complicated by the existence of the disease in two chief forms, one of which involves particularly the interlobular septa and the parenchyma of external secretion, while the other attacks chiefly the islands of Langerhans and only in lesser degree the secretory tubules and interlobular structures. In the interlobular form of the disease digestive symptoms predominate. In disease of the islands of Langerhans, as is well known since the researches of Opie, disturbance of carbohydrate metabolism results, manifesting itself in the more pronounced cases as diabetes. Both

these processes when clinically recognizable and demonstrable are characterized pathologically by parenchymatous degenerations of advanced degree and the deposit of fibrous tissue and fat in the gland.

When this state of affairs is present it is useless to expect cure in the sense that the damage done may be repaired or even compensated for in any marked degree. It is quite comparable to chronic nephritis of the type characterized by deterioration and degeneration of the renal cells with interstitial fibrosis. Partial or complete arrest of the process may at times be effected by removal of the cause of the disease or by careful palliative treatment along empirical lines. But for practical purposes we may consider such cases as having acquired a chronic condition that will necessitate at best a degree of invalidism and in general will sooner or later, directly or indirectly, be responsible for the death of the individual so affected. We have on a number of occasions had the opportunity of reopening the abdomen in a case the subject of chronic indurative pancreatitis, and in no instance have we witnessed a return to a normal condition. We have also operated upon a number of cases of diabetes in which there was good reason to believe that the process was inaugurated by inflammation of the biliary passages. In no case of well-established diabetes did a cure of that condition result, so far as we are able to determine. On the other hand, transient glycosuria, present during exacerbations of biliary and pancreatic disease, we have seen entirely relieved by appropriate operative treatment of the underlying condition. These experiences clearly point the lesson that treatment of the chronic form of pancreatic disease must be directed at the early stages if it is to be effective. We must prognosticate the probable course of early lesions and act with promptness in order to prevent their development.

Owing to the inaccessibility of the pancreas and the difficulties of observation, the slow transitional gradations from early lesions to late effects have never been followed in the individual, nor has a complete series of changes been compiled

by the pathologist because of scantiness of early material, and the difficulty of study of finer parenchymatous changes, owing to the self-digestion of the organ which begins probably in the agonal stage and rapidly proceeds in the first few hours after death. We must therefore have recourse to deduction based upon operative findings, clinical experiences and, only to a lesser degree, upon the late findings of the mortuary.

Several facts have been established. First, a very considerable proportion of pancreatic inflammation is associated with, and in all human probability secondary to, inflammatory lesions of the alimentary tract and its derivatives. The biliary tract and the duodenum head the list by reason of their contiguity. There is reason to believe that the stomach, the appendix, and possibly the colon and remainder of the intestine may at times be primarily responsible.

The second fact of importance, and one which has been repeatedly verified, is the common involvement of the head of the pancreas and the relative immunity of the body and tail of the organ in inflammations transmitted to it from an inflamed biliary tract or duodenum. As we have pointed out previously, this behavior does not square with the current conception of the pathogenesis of pancreatitis, namely, that it is in the majority of cases a duct-borne infection. It is difficult to conceive of an infection of the ducts which could so generally select but one portion of the duct distribution as its seat, to the exclusion of the other areas communicating just as freely with the terminal ducts of discharge. Would we not rather believe, on anatomical grounds, that the head of the pancreas would show the lesser lesions, since in a considerable proportion of cases it possesses an additional functionating path of discharge of its secretion through the duct of Santorini, which can in no way be affected by what has been aptly termed the "unfortunate association of terminal facilities" of the duct of Wirsung and the common bile duct?

A better explanation of the early pancreatic swellings and inflammations seen at operation exists in the close association

of the lymphatics of the gall-bladder, the liver, and the duodenum with those of the head of the pancreas. In former communications we have described the lymphatics leading from the gall-bladder, the bile ducts, and the duodenum in their relation to the head of the pancreas where they anastomose intimately with the lymph vessels of that organ. We have observed clinically indications of the march of the infection most typically in cholecystitis where, in sequence, we have found the inflamed gall-bladder, enlargement of the cystic lymph gland, infiltration of the gastrohepatic omentum, hyperplasia of the glands about the common duct, peripancreatic infiltration and enlargement of the head of the pancreas. We have shown that the areas of pancreatic infection correspond with the lymphatic distribution and not with the duct distribution. For this condition we have adopted the term pancreatic lymphangitis proposed by Arnsperger, and have suggested that the condition probably is, in a percentage of cases at least, the forerunner of the alterations characteristic of chronic pancreatitis.

This condition occurs with cholecystitis with or without stones. It is, so far as we are aware, undiagnosable, except by direct inspection and palpation at operation. It cannot, therefore, be regarded as an indication for operation except in the cases characterized by more persistent and severe exacerbations.

Our knowledge of the existence of this condition must affect our ideas of treatment in two ways: (1) In emphasizing the necessity of prompt and radical treatment of abdominal diseases, particularly those of the gall-bladder, which do not yield readily to internal measures; (2) in influencing our operative procedures in cases where this condition is present as a complication during operation. A recent instance of the disasters of delay in cholecystic disease is the following:

The effect of our knowledge of the dissemination of infection by way of the lymphatics has been to diminish our faith in simple drainage of the gall-bladder or ducts as a cure-all for biliary and pancreatic infection. It is well known that there

is a percentage of recurrences of biliary infection after drainage operations. This is more common in simple cholecystitis than in calculous disease of the gall-bladder or ducts. In a considerable number of cases obstruction of the cystic, common or hepatic ducts seems to play no part. At least there is no evidence of obstruction in the shape of a demonstrable cause or in dilatation of the ducts by back pressure. In such cases, however, mucosal and interstitial infection of the wall of the gall-bladder may be present. If it is not dependent upon intermittent or constant obstruction for its foothold it is not likely that freer drainage will completely dislodge it and it is in these cases that our operative results have proved most unsatisfactory from the stand-point of permanent cure. It is true that some cases are cured and the majority benefited temporarily by simple cholecystostomy, and reasoning along these lines it has been proposed to do cholecysto-duodenostomy, -gastrostomy or -enterostomy in cases complicated by chronic pancreatitis, with the idea of providing permanent free drainage. Unfortunately for the idea it has been found that such a fistulous opening does not remain permanent in the absence of an obstruction to the natural course of the bile. There is but one course open, therefore, which is the removal of the gall-bladder, in which, as a rule, the lurking-place of the infection is found. While for years we defended cholecystostomy and decried cholecystectomy except for the most evident indications, we have come to believe that the field for cholecystectomy should be widened and that all gall-bladders should be removed that show evidence of chronic infection independent of obstruction and particularly so if the pancreas is involved. We believe also that in calculous cholecystitis, which shows evidence of marked interstitial disease and disseminated lymphangitis the chances of permanent cure are enhanced by cholecystectomy.

Naturally in each case good surgical judgment will weigh the increased immediate danger of an operation of greater magnitude against the question of permanence of results. In suitable cases with good technique we do not believe that the

danger will be much, if at all, increased by cholecystectomy. Such has been Kehr's experience. In this country cholecystectomy has had a distinctly higher mortality, which is due chiefly to the fact that it was reserved for more serious and complicated cases. Still, in the presence of great operative difficulties or when dealing with a poor surgical risk, we would not-advocate cholecystectomy for these indications, since simple drainage cures many and it is our creed, frequently stated, that a living patient after two operations is better than a dead patient after one thorough operation.

Another point of great importance is drainage of the common duct in connection with cholecystectomy. This is best done with the T-tube. It should never be omitted, for the reason that it greatly diminishes immediate danger and renders recurrence less likely. We always run a risk of misinterpreting the basic lesion, and we are not willing to discard the known benefits of drainage in so many cases. It is possible also by choledochotomy to pass a searcher into the ducts and down into the duodenum and thus dismiss the possibility of stone or stricture. There is a group of obstructive cases in which the only cause that can be found is stenosis of the papilla of Vater. Whether this is due to a spasm of the sphincter of Oddi or to inflammatory changes in the tissues surrounding the orifice is not definitely known in all cases. Certainly many are inflammatory, and particularly those cases of complete and lasting obstruction associated with jaundice cannot be interpreted as sphincterismus. It seems not unlikely, however, that spasm of the sphincter does occur and is productive of symptoms. Divulsion of the papilla by a large searcher or gall-stone scoop is curative in these cases. When the gall-bladder is removed we must realize that we are taking away the "tension bulb" of the biliary tract, the mechanism by which transient back-pressure is prevented from exerting its full effects upon the liver directly. It is of paramount importance, therefore, to be sure that nothing exists in the nature of an obstruction to the free discharge of bile into the duodenum. Slight or intermittent obstruction at

the papilla is not sufficient to enable the surgeon to recognize the condition by the appearance of the common duct and it is therefore wiser to eliminate it in the manner here suggested.

Finally, it must be said that the most important message that the surgeon has for the profession, as the result of the increase of knowledge of pancreatic disease made possible by the autopsy *in vivo*, is the necessity of referring intractable dyspeptics to the surgeon. It is not enough that the internist by diets, drugs, and trips to Carlsbad, French Lick Springs and the like, can lull infected gall-bladders and ulcerated duodenums into temporary quiescence. If by recurrences and chronic disturbances it is evident that sterilization of the infected area has not been accomplished, he should realize that he is exposing his patient to most serious damage to the parenchyma of essential organs which can never be repaired.

ARTHROPLASTY FOR INTRA-ARTICULAR BONY AND FIBROUS ANKYLOSIS OF TEMPOROMANDIBULAR ARTICULATION

REPORT OF NINE CASES

By JOHN B. MURPHY, A.M., M.D., LL.D., F.R.C.S. (Eng.)
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Arthroplasty, or the technique for the formation of new joints, may be divided into seven different stages in its evolution, and each stage has been initiated or created by the work of a single individual and then his succeeding school. These stages are:

1. The formation of fibrous or flail joints, as of the shoulder and elbow (Langenbeck, Ollier, Julius Wolff, and others). These were desired sequences following resections for diseased joints, as tuberculosis, syphilis, pus infections, etc.

2. The restoration of mobility in a bony ankylosed joint by the interposition of fibrous tissue between the separated ends at the ankylosed joint, as in the mandible (Helfreich, 1893, who was the father of this method).

3. Pseudo-arthrosis developing after osteotomies in the neighborhood of joints (Lorenz), as in hip ankylosis.

4. The transplantation of pedicled flaps of fascia and fat and capsule, with the production of a movable, sliding joint and a hygroma (Murphy, 1902), in the mandible, hip, knee, elbow, shoulder, and wrist.

5. The homotransplantation of the articular ends and surfaces of bone (Lexer, 1906), particularly in the knee.

6. The transplantation of free fat and fascia (Lexer).

7. The interposition of foreign material to make the joint, from Péan's metallic joint down to Kraske, Baumgarten, Roser, and Baer's heterovisceral implantations.

The fourth stage, or the transplantation of pedicled flaps of fascia with fat and capsule, is the one now in vogue. It is to be hoped that the free fascia and fat transplantation of Lexer will with future experience sustain the good results which its originator predicts for it, as there are many cases in which a pedicled fat and fascia flap are not available, on account of the anatomic conditions and particularly the pathologic sequences preceding or associated with the development of the ankylosis.

Heteroplasties and the insertion of foreign material are doomed to disappear from this field of work, as foreign absorbable material, if aseptic, must eventually be supplanted by connective tissue; and while a flexible joint may be present, a movable sliding joint cannot result from such interposition. Non-absorbable metal materials can be serviceable only under a few very favorable conditions.

So much for the general subject of new joint formation or arthroplasty. Concerning arthroplasty of the jaw, I would say that ankyloses of the jaw may be divided into (1) the intra-articular fibrous and osseous, and (2) the extra-articular cicatricial, varieties. The latter may also be termed the interalveolar or cheek cicatricial fixation, the result of sloughing in the mouth and infections of the subzygomatic zone.

Routes of Invasion of the Joint. The most common type of ankylosis is the bony. It may be due to:

1. An extension of a suppuration from the middle ear (Case 1).

2. A mandibular osteitis extending to the glenoid cavity.

3. A metastasis from foci of infection elsewhere in the body (Case 9), or it may be part of a general metastatic arthritis (Case 7).

4. It may be the result of a transmitted trauma from the chin (Case 4).

The ankylosis may involve the head of the mandible only, or

it may extend across to the coronoid process, so that the lower maxilla is firmly welded to the temporal bone and the base of the zygoma by the new bone formation. It is common to have it include the anterior root of the zygoma.

In most cases the cause of the ankylosis is a middle-ear suppuration. If one follows the anatomic course of these suppurations, it is obvious how the mandibular articulation becomes involved. Infections of the middle ear penetrate in five different directions:

1. The infection may pass backward into the mastoid.

2. It may pass through the posterior wall of the petrous bone into the posterior cerebral fossa.

3. It may penetrate the attic of the ear, form an abscess within the middle cerebral fossa and rupture externally just above the tip of the ear.

4. The abscess may burrow forward and rupture into the glenoid cavity or pass over the base of the zygomatic process into the mandibular articulation.

5. The abscess may burrow forward into the subzygomatic temporal muscle zone and produce a great phlegmonous myositis with subsequent cicatricial contraction.

In the case of para-articular fixation, due to the formation of cicatrices, the condition is usually caused by a sloughing of the mucous lining of the cheek, such as follows typhoid fever, scarlet fever, or measles (noma), infections of the alveolar processes, subzygomatic infection from penetrations through the mouth or cheek, from infections of the scalp or cranium by producing destruction of the fascia and temporal muscle which may contract in the process of repair and so cicatrize as to fix the jaw absolutely on that side.[1]

Differential Diagnosis. The differential diagnosis as to which side is involved is often extremely difficult. When the ankylosis is bony, there is complete fixation of the jaw. When

[1] Murphy, John B. Use of Palate Mucous Membrane Flaps in Ankylosis of the Jaw Due to Cicatricial Formations in the Cheek, Jour. Amer. Med. Assoc., July 24, 1911, p. 245.

the ankylosis is fibrous, there is some motion in the jaw, depending on the degree of joint involvement (Case 3). In the para-articular ankyloses, there is always some motion in the jaw. In the intra-articular ankyloses, there is sometimes a little lateral motion on the unaffected side, from $\frac{1}{60}$ to $\frac{1}{100}$ inch on forced effort at opening the mouth, a point in diagnosis which is well worth remembering.

I have learned by clinical observation and experience that a diagnosis of the side involved can be made accurately (when only one side is affected and if the condition occurred early in life) by noting the deviation and contrast formation of the two sides of the face. The face on the side of the ankylosis is full and round and apparently normal in appearance. On the opposite or unaffected side it is flattened and deformed. The chin is always more or less retracted and deviates toward the ankylosed side. If the ankylosis occurs after the patient has attained full growth, this deviation is only slight in degree; but if it occurs in infants or children, the deviation and retraction are marked, increasing in degree as the patient grows older. The earlier the ankylosis has occurred in life, the greater the deformity of the face (Case 1). The fixation of the joint interferes with the proper development of the jaw. The epiphysis of the condyle is the means through which the ramus grows in length. This growth is arrested by the ossification across the epiphyseal line before the normal time for ossification, which is the fifteenth year. All of the other five centers of ossification are united by bony formation before birth. The absence of use of the jaw undoubtedly is a contributing factor to its aplastic condition. When the ankylosis is a recent one there is not much deformity (Case 4).

Physical Findings. The physical findings in these cases are the following:

1. There is flattening of the jaw on the unaffected side, most pronounced near the tip of the chin.

2. When the patient attempts to open his mouth, the teeth move from $\frac{1}{60}$ to $\frac{1}{100}$ inch downward and deviate a little

in the direction of the ankylosed side, because of a slight sliding forward of the mandibular articulation on the unaffected side as the muscles of the neck are put on tension in the effort made to open the mouth.

3. A sliding motion on the unaffected side can be felt by the palpating fingers, and the muscular activity on that side is very much greater on attempted opening of the mouth than on the ankylosed side.

4. The muscles on the ankylosed side are more atrophied than those on the unaffected side.

In only one case (Case 1) of this series of nine intra-articular ankyloses of the temporomandibular articulation was there failure to diagnose the side affected, and in that case I was entirely misled by the history given us. All the data, including the mother's information, pointed to the left side as the one involved in the original lesion (a middle-ear abscess which had been opened and drained), when, as a matter of fact, the ankylosis was on the right side, and therefore the history could not have been correct. That case taught me to base the diagnosis on the points mentioned above rather than on the history.

Technique of Operation. In all of these cases of ankylosis of the jaw of the intra-articular type I have performed a typical and uniform arthroplasty, and the results which we have obtained have justified me in advocating this exact technique for these cases. The technique of this operation is not difficult, but it must be exact in its details in order to secure good results. I have employed the pedicled flap as the interposing material. It consists of fat and the aponeurosis of the temporal muscle and sometimes includes a few muscle fibers.

In my earlier operations I fixed the tip of the flap to the connective tissue and internal portion of the capsule. Later I abandoned this procedure, and now I fix the flap at the basal angles only; by this method there is not that danger of injuring the internal maxillary artery, an accident which I encountered in one of my early cases. This flap is of the same shape and material as that used in my operations in 1902, but at that time

I brought the flap under the zygoma down into the joint, while now I turn it over the zygoma into the joint.

At first I exposed the joint by a perpendicular incision just in front of the ear, extending from one and one-half inches above the zygoma in the hair-line downward to the lower border of the zygoma. Later I modified this incision, curving it slightly forward on the temple at its upper extremity. And then I adopted

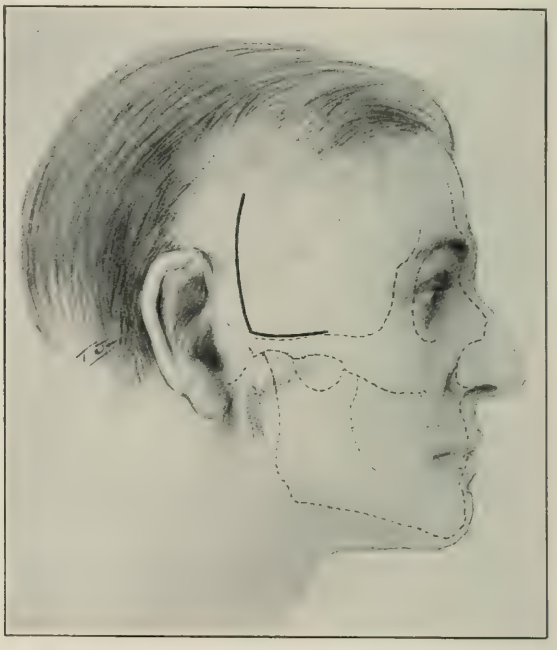

FIG. 1.—The line of incision and the bony outlines at the point of ankylosis.

an L-shaped incision (the one I make now); the perpendicular portion comes down to the upper border of the zygoma and then extends forward along its upper margin for a half to three-quarters of an inch, making the longitudinal portion (Fig. 1). That is a very satisfactory incision, one which leaves a very slight scar, most of it being hidden in the hair. It gives better access to the joint than does the perpendicular incision, because in

some of my cases of bony ankylosis, the ankylosis extended forward on the zygoma from the glenoid to the coronoid process. The perpendicular incision is made for the purpose of securing the fat and fascia of the temporal muscle.

I have divided the ankylosis by means of chisels, Gigli saw, or with an olive-tipped dental burr driven by an electric motor. The latter is much more rapid, but, on the whole, is not so satisfactory, I believe, as the chisel. It is needless to point out that the greatest caution is required in the use of the chisel, or the burr for that matter, because of the close proximity of the brain, which is separated from the head of the mandible only by a very thin transparent plate of bone.

Details of the Operation. After the incision has been made, as described above, the edges of the wound are retracted, the lower lip being displaced downward over the lower border of the zygoma, in order to give a good exposure of the joint. Then the tissues are separated with a special curved periosteotome (Fig. 2, *A* and *B*) all around the anterior surface of the line of union, and further separated with a similar instrument around the posterior surface. When the bone is laid bare, the two instruments are passed behind the neck of the bone, one from each side, so that when they are in place they completely encircle the neck of the mandible behind close to the head, holding the soft parts retracted during the excision of the bone, so that the articulation is fully exposed (Fig. 3). The insertion of these instruments and their retention in position during the excision of the bone form the key to the success and safety of the operation. Injury to the internal maxillary artery, which closely hugs the neck of the mandible, is thus avoided. These periosteotomes also act as retractors, keeping the field open for inspection during all of the work. The chisel or burr then divides the bone on the level of the tubercle, without endeavoring to remove the articular surface of the head of the bone, as there is danger of penetrating the base of the skull when an effort is made to excavate all of the head. If bony ankylosis is present, one-third inch of the neck is excised, so

that one can put the tip of fat finger between the divided fragments across the space over the inner margin of the neck at the

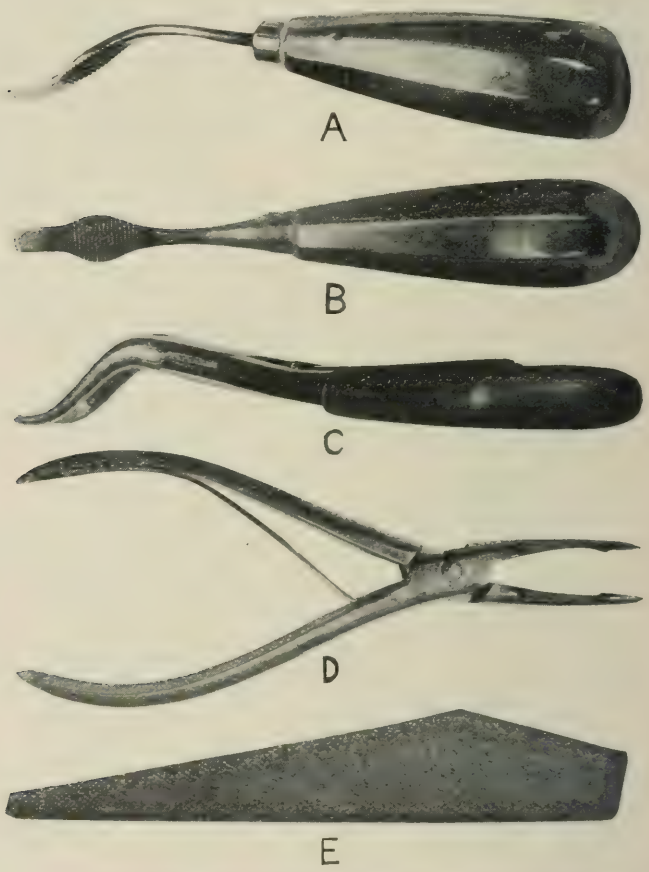

FIG. 2.—*A*, *B*, Dr. Murphy's periosteotome, side and back view (somewhat reduced); *C*, *D*, bone-cutting forceps or nippers, side and front view (somewhat reduced); *E*, the interdental block designed by Dr. Murphy to maintain the desired spread of the jaws. It is made of wood and since it is wedge-shaped, the degree of opening can easily be regulated by withdrawing or pushing in the block.

base of the zygoma. This must be done carefully, and ample bone must be removed, so as to admit of the insertion of the

interposing flap of fat and fascia. The periosteum should be left attached to the bone that is removed. The deeper fragments of the bone can be taken out with a small rongeur (Fig. 2, *C* and *D*). If one desires, as soon as the periosteotomes have been passed behind the neck of the bone, a small and full-curved aneurysm needle may be used to carry a silk thread around the

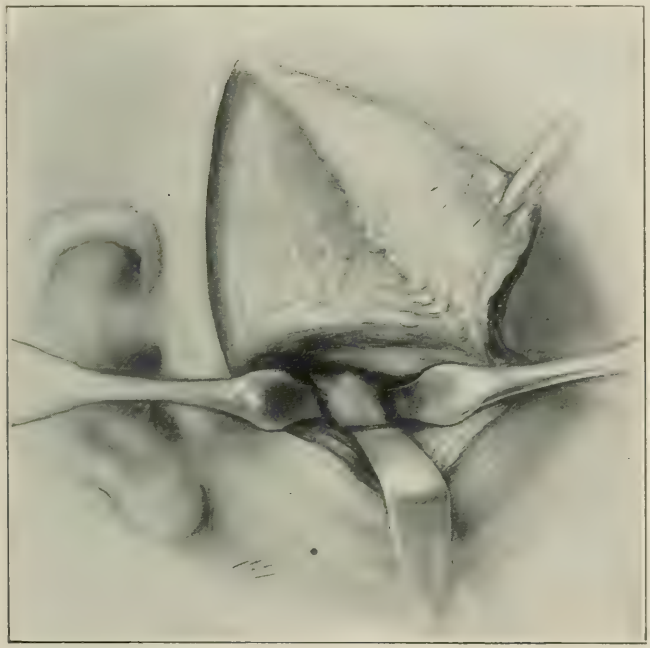

FIG. 3.—The curved periosteotomes encircling the condyle and neck of the mandible.

neck of the mandible. This thread acts as the carrier for the Gigli saw (Fig. 4), which is used to divide the bone; this method is rapid and effective. The difficulty of inserting the saw is slight, but the acute angulation of the instrument, which necessarily occurs, occasionally causes it to break, giving one some inconvenience in replacing it. On the whole, I do not see that it is handled as easily as the chisel. As soon as the bone is com-

pletely divided, the mouth can be opened readily by the anesthetist (Fig. 5).

The interposing fat and fascia flap should now be prepared. The perpendicular incision is elongated up on the temple, say for a distance of one and one-half inches. Then a U-shaped flap of fat and fascia is elevated from over the temporal muscle, about three-quarters of an inch wide and one and one-half inches

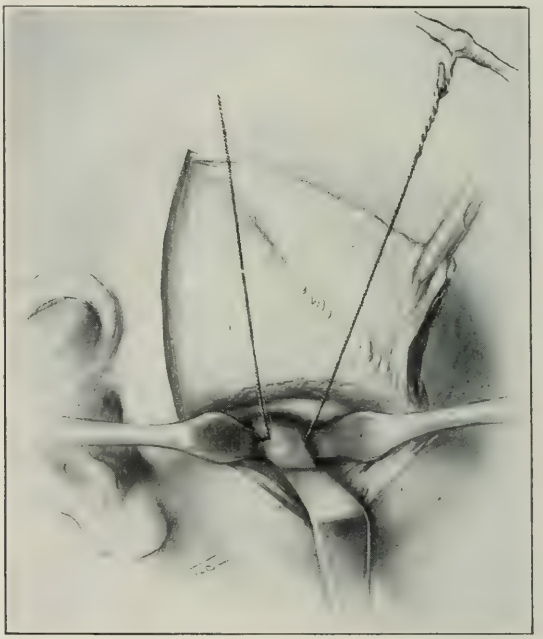

FIG. 4.—The Gigli saw used to divide the mandible.

long, leaving the base attached to the upper margin of the zygoma. This flap is freed from above downward, folded downward over the zygoma and packed into the bony gap previously described, from which a portion of the neck of the bone has been removed. The flap is packed into the cavity, and at its anterior and posterior basal angles it is securely tacked, with a few catgut sutures, to the fascia and periosteum, so as to retain it in

position (Figs. 6 and 7). Then the skin wound is accurately closed with horsehair, dusted with bismuth subiodid, and sealed with collodion gauze. No other dressing needs to be applied. The scar is scarcely perceptible and is almost entirely within the hair-line.

FIG. 5.—The gap left after the exsection, with the curved periosteotomes still *in situ*.

No special effort should be made at this time to spread the jaws, as it is important that the lower jaw should remain steadied on the well side in order that the wooden block (Fig. 2, *E*) inserted on the diseased side may maintain the wide separation of the molar teeth, until the interposing flap has healed in. This block also prevents compression and necrosis of the flap.

Summarizing the whole technique, the steps of the operation are as follows: (1) the L-shaped incision; (2) division of the ankylosis and removal of a segment of the mandibular neck;

FIG. 6.—The temporal fascia and fat flap freed and prepared for insertion.

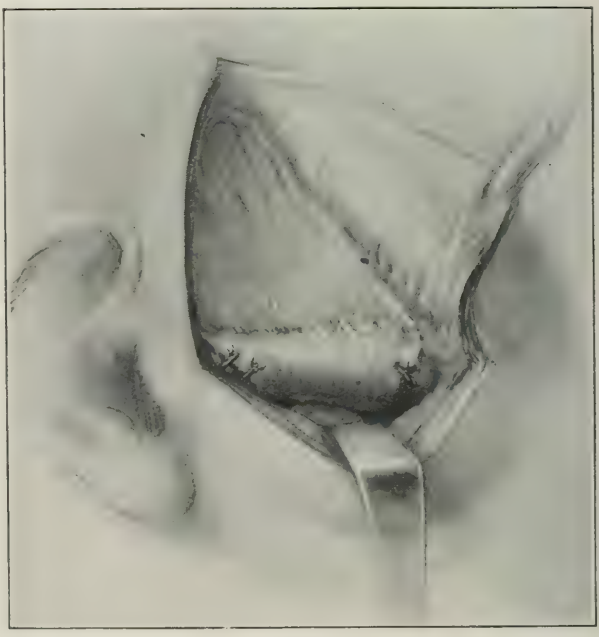

FIG. 7.—The temporal fascia and fat flap secured in its interposing position by sutures.

(3) raising the flap of temporal fascia and fat; (4) interposing the flap and fixing it in place; (5) closure of the wound.

Results. The results which I have obtained in these cases have been satisfactory. The operation is one of the most gratifying in surgery, so far as results are concerned. There has been but one ultimate failure, and that I believe was due to one of three factors: (1) I did not remove the periosteum with the bone; (2) there possibly was absorption of the interposing flap with ossification of the new-formed connective tissue, as occurs in detached trochanteric fascial flaps in arthroplasties on the knee and other joints, and (3) the parents did not carry out the instructions as to maintaining the wooden plug in position after the patient left the hospital.

In this case (Case 4), seen last nine months after the operation, there was limitation of motion, but not a bony ankylosis. The boy's parents did not attend to the blocking of the teeth since his discharge from the hospital two weeks after the operation, as they were instructed to do. He had good motion immediately after the operation. The immediate successes have been complete.

I have had nine cases of intra-articular ankylosis and two of extra-articular fibrous fixation. In the last-mentioned two cases, I employed the method which I believe is original with me. It consisted in the utilization of mucous membrane pedicled flaps taken from the hard and soft palate as an interposing medium between the divided cicatricial connective-tissue masses for the purposes of preventing a recurrence of the fixation.

REPORTS OF CASES

Case 1.—*Ankylosis of Right Temporomaxillary Articulation.* F. D., boy, aged fifteen years, was admitted to Mercy Hospital, Sept. 3, 1912, on account of absolute fixation and deformity of the lower jaw. The history given by his family was as follows:

When he was six months old a swelling developed rather

suddenly in front of the tragus of the "left" ear. A few days afterward pus discharged from the ear through the external canal for four or five days and then the swelling disappeared. There was no swelling over the mastoid then nor has there been since. In fact, there has been no further trouble in that ear. His parents stated that he had no throat or skin trouble and that there was no noticeable deformity of the jaw then. Not until twelve months after the ear trouble did they note that his jaw was fixed. Since then he has been unable to open his mouth.

Examination. The lower jaw is deformed. The normal angle is absent. The chin is narrow, pointed, recedes and is situated to the right of the median line. The molar teeth articulate normally, but the upper front teeth project beyond the lower about half an inch. The skin for a thumb's breadth to the left of the symphysis menti is contracted. This contraction extends into the tissues of the neck. The lower jaw is pressed firmly against the upper, so that the patient has no motion in any direction. There are no enlarged lymph nodes preceptible in the neck. There is no discharge from either ear now and no signs of a recent or old mastoid trouble. There is also a marked retraction of the jaw, with a considerable flattening of the left side of the face (Figs. 8 and 9).

Operation. As all the data which could be obtained in this case pointed to the left side as the seat of the trouble, it was concluded to operate on that side. September 7, 1912, a two-inch perpendicular incision was made, extending along the front of the ear on the jaw, commencing an inch and a half above the zygoma and extending down to its lower margin. Most of the incision was in the hair-line, so that very little of the scar would be visible later. The tissues were divided close to the ear, retracted forward on the cheek and down below the zygoma out of the field of operation. The joint was exposed at once. There was no intra-articular ankylosis, but a capsular contraction was present, the result of the long fixation of the joint. The attachment of the temporal muscle in the mandible was

freed, but the jaw remained fixed. A second incision was made just beneath the angle of the jaw parallel with the ramus, and through this the masseter was freed from its attachment, as well as the internal pterygoid. Still there was not a particle more motion in the jaw than before.

The röntgenograms in this case were very indefinite, as they usually are in these cases, and no assistance was received from them.

FIG. 8

FIG. 9

FIG. 8 (Case 1).—Marked flattening of left side of face and fulness of right side. Considerable deviation of chin to the right of the median line.

FIG. 9 (Case 1).—Great retraction of the chin; in fact, there is hardly any chin. This is characteristic in these cases, when the condition occurs early in life.

This being one of the early cases of ankylosis of the jaw, I had not yet learned to recognize from the facial deformity which side was involved. Later, I learned that the full side of the face was the one to attack and not the flattened side. The failure to get the jaw to drop after the division of these three muscles led me to the conclusion that a mistake might have been made by the parents and friends of the boy in giving us the history, and that it was the right and not the left side which had been involved primarily when he had his ear trouble. Therefore I immediately exposed the right mandibular articulation.

An incision similar to that which was made on the left side

was made in front of the right ear. The zygomatic attachments were divided at the ear and retracted onto the face out of the field, and when the joint was exposed, I found a bony ankylosis of the articulation, extending forward to the tubercle on the zygoma. It was one solid bony mass. This showed conclusively that the error had been made by the boy's parents in stating that it was the left side that had been involved in the middle-ear infection. My findings showed that it must have been the right side. This ankylosis was divided about a line below the anatomic articulation with a carpenter's narrow straight chisel, a portion of the condyle of the mandible was removed and the jaw immediately dropped down. There was free motion. A flap was then raised from the temporal muscle, consisting of fascia and fat. The tip of the flap was turned down into the joint and interposed between the temporal bone and the mandibular neck, so as to prevent the recurrence of the ankylosis. The flap was tacked in place at its tip to the internal capsule on the neck of the mandible with a few chromicized catgut sutures. The zygomatic attachments were replaced in their normal position and fixed. The deeper portion of the wound was closed with catgut and the skin incision with horsehair. The wound on the left side of the face was also closed with horsehair. Collodion gauze dressings were applied.

Result. On the morning of the next day the patient was able to open his mouth voluntarily far enough to introduce two fingers. Further progress was uneventful. He had motion in his jaw, free and voluntary, and no pain. The stitches were removed on the sixteenth day. There was primary wound healing. The range of motion was increased rapidly by placing a wooden wedge between the teeth. Word was received from the boy six months later that he could hold an apple in his mouth (Fig. 10).

This case is interesting because of the fact that ossification occurs in certain white fibrous structures in the embryo, and these structures have a tendency to ossify in postnatal life, if subjected to infection or irritation.

The result in this case was encouraging in every way, and in none of the subsequent cases did I fail to make a correct diagnosis as to which side was involved.

FIG. 10 (Case 1).—Six months after operation; patient's mouth wide open.

CASE 2.—*Ankylosis of Right Temporomandibular Articulation.* A. D. C., man, aged twenty-four years, was admitted to Mercy Hospital, April 9, 1913, on account of ankylosis in the lower jaw. Eighteen years ago he was kicked by a horse on the left side of the jaw just posterior to the mental angle, and sustained a compound fracture at this point. The wound suppurated and discharged pus for about two months, when a sequestrum of bone or a tooth—he does not know which—was extruded from the wound, which then healed. Immediately after the accident the patient also had a discharge from the right ear which persisted for some time, he does not know just how long. He never had any pain in the ear before the discharge appeared or afterward. The fixation of his jaw was consequent to this ear discharge. In order that he might feed himself the upper right canine and bicuspid were removed (Fig. 11). The personal and family histories were otherwise negative.

Examination. The lower jaw was fixed and immovable. The right side of the face was full and round (Fig. 12). The left side was slightly flattened from the angle of the jaw to the chin. The latter deviated to the right of the median line; the patient also had a considerable retraction of the chin. The röntgenogram (Fig. 13) showed a complete obliteration of the

right temporomandibular articulation. There was a bony ankylosis extending forward on the tubercle of the zygoma.

FIG. 11

FIG. 12

FIG. 11 (Case 2).—The lips are retracted to show the fixation of the jaw and the gap in the denture through which the patient fed himself for eighteen years.

FIG. 12 (Case 2).—Lateral view, showing the retraction of the chin. It is evident that that side of the face, the right, is not flattened. It was the right articulation that was ankylosed.

FIG. 13 (Case 2).—Röntgenogram of right side of head made before operation, showing the complete obliteration of the temporomandibular articulation.

Operation. April 17, 1913, the articulation was exposed by a two-inch curvilinear incision beginning at the lower level of the tubercle of the zygoma half an inch in front of and on a line with the external auditory canal and extending upward into the hair in a curved direction. By retracting the wound edges and elevating the periosteum with a periosteotome, the site of the articulation was exposed. All anatomic landmarks were lost. An elevation that felt like the head of the mandible was visible and there was some fibrous tissue resembling the capsule of the articulation. There was no motion in the joint. The periosteum was very carefully removed from the head of the bone, and the ankylosis was divided with a narrow, straight chisel. It extended forward to the tubercle, binding the mandible firmly to the zygoma. The head of the mandible was then removed with a bone-cutting forceps, leaving a space half an inch in width in which was placed the flap of fat and fascia deflected from the temporal muscle. The temporal flap measured two inches in length and an inch in width. It was raised from the temporal muscle and dropped down over the zygoma into the glenoid fossa, so as to cover the raw bony surfaces completely. The tip of the flap was fastened to the capsule on the internal surface of the mandible by means of a few tacking catgut sutures. The basal angles were likewise fixed. The skin wound was closed in the usual manner.

The jaw moved quite freely after the operation. It was found that the opposite articulation was quite stiff, owing to a fibrous fixation, but nothing was done at this time to overcome it, as I preferred to keep it set until the wound healed and the vitality of the flap was assured. A week later the patient was again anesthetized and this fibrous fixation was overcome by forcibly prying open the mouth, care being taken not to injure the teeth or to fracture any of the bones. Success attended this effort.

Result. The day following the operation, the patient had free voluntary motion in the jaw, which increased rapidly in range. The stitches were removed on the tenth day. There

was primary wound healing. The mouth could be opened for one inch. When the patient left the hospital on the twenty-second day he could open his mouth for a distance of an inch and a half. A report received nine months after the operation states that the result is a most satisfactory one (Fig. 14).

There are several interesting points in connection with this case which bear emphasis. This man was kicked by a horse on the left side of his face and had a discharge from the right ear. He had no scar on the right side of the face. He evidently had a metastatic infection in the right temporomandibular articulation, and the abscess opened into the ear. He did not

FIG. 14 (Case 2).—Eleven months after operation; patient able to open the mouth practically to the normal degree.

have an extension of the infection throughout the entire length of the chin, such as one encounters in mouth infections, typhoid infections or phosphorous necrosis, in which the whole lower jaw from symphysis up to the mandibular articulation may be involved, so that the head of the bone becomes necrotic and is exfoliated. In those cases the whole jaw may be removed as a sequestrum. There was no evidence that this patient had any such infection. We do know, however, that he had an injury of the left side of the jaw, and that he had an infection in the right temporomandibular articulation. That is the condition which produced his ankylosis.

CASE 3.—*Fibrous Ankylosis of Left Temporomandibular Articulation.* W. B., boy, aged six years, was admitted to Mercy Hospital, May 22, 1913, on account of inability to open his mouth more than half an inch. The boy was an eight-months' child, born during a dry labor lasting twenty-four hours. It was early noticed that the child had difficulty in nursing but the reason for this was not discovered. When the boy was eighteen months old, the mother noticed that the right side of the face was deformed, that is, it was flattened. The left side appeared to be full and round. About this time the boy had pneumonia and when the attending physician attempted to introduce a spoon into the mouth for the purpose of examining the throat, he was unable to do so. When the boy was three years of age, his mouth was pried open and a cork was placed between the teeth. As soon as the cork was removed, however, the jaw immediately closed down to half an inch. The patient has never had any other illness than the pneumonia; no nose, throat, or ear trouble, and no injury. He has been fed through a gap made in the upper and lower dentures by the extraction of a tooth in each.

Examination. The physical deformity was striking (Fig. 15). The left side of the face was full and round. The right side was flattened over the body of the inferior maxilla. The mouth was slightly twisted; the chin was displaced to the left of the median line and receded. The patient could open his mouth for a distance of only half an inch (Fig. 16). There was a slight antero-posterior sliding motion in the right temporomaxillary articulation. There was no lateral motion whatever. The röntgenograms, one showing the mouth closed and the other open, were somewhat indistinct. The articulation was not clearly outlined, but the coronoid process seemed to change position when the mouth was open, so that I concluded that it was probably only a fibrous ankylosis of the left temporomandibular articulation, an opinion confirmed at operation.

Operation. May 23, 1913, the articulation was exposed by means of the perpendicular incision made immediately in front

of the ear, extending from a point half an inch below the zygoma, upward in the hair-line for a distance of two inches. By retracting the wound edges the articulation was easily exposed. On moving the jaw it was found that the coronoid process was free, but that there was a fibrous ankylosis between the head of the mandible and the fossa. By means of a scalpel and a narrow

FIG. 15

FIG. 16

FIG. 15 (Case 3).—The fulness of the left side of the face, the flattening to the right of the chin and the displacement of the latter to the left are very evident.

FIG. 16 (Case 3).—The extent to which the mouth could be opened and the gap in the denture through which the patient was fed.

quarter-inch straight carpenter's chisel the ankylosis was divided and about one-quarter inch of the head of the bone was removed, so as to make room for the interposing flap, which was reflected from the temporal muscle aponeurosis in the usual manner. The flap was one and one-half inches in length and three-quarters of an inch wide. It was dropped down over the zygoma into the joint, so as to cover the raw bony surface of the condyle. It was

held in place by means of two tacking catgut sutures, one at each basal angle of the flap (Fig. 7). The skin wound was then closed in the usual manner.

Result. On the morning of the following day the boy had free motion in the jaw in spite of the fact that there was a considerable edema of the left side of the face, especially of the field of operation. The stitches were removed on the ninth day. Primary wound healing occurred. The edema rapidly subsided and motion increased to such an extent that when the patient left the hospital, about three weeks after the operation,

FIG. 17

FIG. 18

FIG. 17 (Case 3).—Thirteenth day after the operation; extent to which the patient could open his mouth.

FIG. 18 (Case 3).—Degree to which the patient could open his mouth voluntarily eleven months after operation.

he could open his mouth easily a distance of an inch and a quarter (Fig. 17). A report received April 4, 1914, reads as follows: "The result I am sure will please you, as it is a perfectly splendid one" (Fig. 18).

This is the only case in this series in which there was an extensive edema of the face following the operation. The swelling was enormous and was undoubtedly caused by the manipulation of the tissues, and while it temporarily prevented active efforts on the part of the patient to move his jaw, it did not interfere with the final result, which was splendid. This,

too, was the only case of intra-articular fibrous ankylosis. It did not involve the coronoid process which was free, as shown in röntgenograms of the mouth opened and closed. It will be noted that the operation which was performed in this case is similar in principle to that performed in the cases of bony ankylosis.

Case 4.—*Ankylosis of Left Temporomandibular Articulation.* D. C., boy, aged thirteen years, was admitted to Mercy Hospital, June 6, 1913, because of complete fixation of the lower jaw. In September, 1909, the patient fell from a third-story window, a distance of forty-five feet, landing on a brick pavement. He alighted on his feet, but his knees were flexed forcibly and the body bent forward, so that the chin impacted with the knees. The result was two lacerations of the skin over the chin and several broken teeth. He was picked up unconscious, bleeding profusely from his nose, mouth, and ears. He was taken to the hospital and remained unconscious for three hours. When he left the hospital on the sixth day he was unable to open his mouth. His jaw was fixed and has remained so ever since.

Examination. The right side of the face is slightly flattened. The left side is full and round. He is unable to separate his teeth at all, but because of the retraction of the chin, which is considerable, he is able to feed himself. There is a space of about a half inch on a horizontal line between the upper and lower teeth. Diagnosis: Bony ankylosis of the left temporomandibular articulation (Figs. 19 and 20).

Operation. June 7, 1913, an incision was made along the upper border of the zygoma, extending from the ear forward on the cheek for a distance of about three-quarters of an inch. The skin flap was displaced downward, and the articulation was exposed. A bony ankylosis extending from the condyle to the coronoid process was found. By means of the straight one-quarter-inch chisel, the ankylosis was freed and one-third inch of the condyle and of the coronoid process was removed. The jaw then dropped down freely. A second perpendicular incision

was then made extending from well up in the hairy portion of the scalp downward in front of the ear to the starting-point of the first incision. This gave ready access to the temporal muscle and fascia. The usual flap was raised, dropped down over the zygoma and tucked into the joint, so as to cover all raw bony surfaces. Fixation was maintained by means of two tacking sutures of catgut placed in the angles of the flap. The skin wounds were closed in the usual manner.

FIG. 19

FIG. 20

FIG. 19 (Case 4).—There was not much fulness of the left side of the face or much flattening of the right in this case, the ankylosis having existed for only four years, commencing at the age of 9. There is no deviation of the chin, although there is considerable retraction.

FIG. 20 (Case 4).—Extent to which the patient could open his mouth before operation.

Result. The day following the operation the boy opened his mouth voluntarily for the first time in nearly four years. He rapidly increased the range of motion by means of the wooden wedge which I use in all of these cases and by chewing gum. The stitches were removed on the eleventh day. Primary wound healing occurred. When the patient left the hospital, two weeks after the operation, he opened his mouth freely about an inch and a quarter (Figs. 21 and 22). When

the boy was seen again, first about six months afterward and again nine months afterward, he had almost complete limitation of motion of the lower jaw, the result of neglect to carry out the prescribed after-treatment by means of the wooden interdental block. There was no return of the bony ankylosis, however.

This was the only case in this series, except Case 2, which occurred in an adult, in which the ankylosis was comparatively recent and did not come on early in life. It was the result of a

FIG. 21

FIG. 22

FIG. 21 (Case 4).—About two weeks after operation; extent to which the patient could open his mouth voluntarily.

FIG. 22 (Case 4).—Skin wound two weeks after operation. This is a good illustration of the type of incision usually employed in these cases. The retraction of the chin shows very well in this picture.

distinct and definite trauma and not of an infection. When the articulation was exposed, I could find no trace or evidence of the fracture into the joint, but the history would lead to the belief that there must have been a traumatic fibrous arthritis with subsequent ossification. This is the usual course that follows blows on the chin. The same type of ankylosis occasionally occurs in the elbow-joint when youngsters fall and strike severely on the olecranon.

CASE 5.—*Bony Ankylosis of Left Temporomandibular Articulation.* F. C., boy, aged seven years, was admitted to Mercy Hospital, June 13, 1913, because of complete fixation of the lower jaw. He was an orphan and little of his history could be obtained. His guardians stated that he had never been able to open his mouth since birth. They did not know anything about the labor. When he was a baby (age not given) he suffered for several months with a discharging ear (which one not known), but he had not been able to open his mouth before that time.

FIG. 23

FIG. 24

FIG. 23 (Case 5).—Absolute fixation of the jaw and the gap in the denture through which the patient was fed.

FIG. 24 (Case 5).—Bony ankylosis of the left temporomandibular articulation, with fulness on the left side of the face and some flattening of the right side over the body of the jaw. The chin is slightly deviated to the left.

Examination. It was impossible to separate the teeth. Several teeth had been extracted in the front of the boy's mouth to allow of his being fed (Fig. 23). On an attempt to pry the mouth open, a slight forward sliding motion was detected toward the left side. The left side of the face was full and round. The right side was flattened. The chin was slightly retracted, but the coaptation of the teeth was normal (Fig. 24). Diagnosis: Bony ankylosis of left temporomandibular articulation.

Operation. June 14, 1913, the articulation was exposed as in the previous case by means of the horizontal incision along the upper border of the zygoma and the perpendicular incision to expose the temporal fascia. It was found that the ankylosis was of the bony type and that it extended forward to the zygomatic tubercle. It was freed by means of a small olive-shaped dental burr, operated by an electric motor, and with a small bone-cutting forceps (Fig. 2, *C* and *D*) one-third inch of the condyle was removed. The jaw immediately dropped down. The flap of temporal fascia was then raised from the muscle

FIG. 25 (Case 5).—Photograph made about two weeks after operation, showing how well the patient could open his mouth.

and inserted in the usual manner. The flap was fixed by means of two tacking catgut sutures placed at its basal angles. The wound was closed in the usual manner.

Result. On the following morning the boy could open his mouth for about half an inch. Motion was encouraged by means of the wooden wedge, which was inserted between the molar teeth. The stitches were removed on the tenth day. Primary wound healing occurred. When the patient left the hospital on the sixteenth day he could open his mouth easily an inch and a quarter (Fig. 25).

On May 16, 1914, this patient returned to the hospital with

a complete fixation of the jaw. Examination indicated that there was a bony ankylosis. On the 18th an incision was made similar to the original one and it was found that a complete bony ankylosis had recurred and had extended forward beyond the maxillary tubercle toward the coronoid process. All of the bone was excised, leaving a cavity of one-half inch. A small connective tissue and fascia and fat flap was prepared with the base attached to the cheek tissues below the mandible. This was inserted and fixed by the angular tacking stitches as in previous operations, and the wound was closed in the usual manner.

All of the previous interposed flap had entirely disappeared, probably due to the pressure on account of the failure to maintain the interdental block in the usual way. The day following the operation, the patient had no trouble in opening his mouth voluntarily for three-quarters of an inch.

Case 6.—*Bony Ankylosis of Left Temporomandibular Articulation.* E. F., girl, aged eight years, was admitted to Mercy Hospital, July 10, 1913, because of inability to open her mouth for more than one-quarter of an inch. When she was two and one-half years old she had a cold, but was not ill enough to be put to bed. After two or three days she had severe earache on the left side, and a swelling appeared in front of and behind the ear. A week later she had an abscess in front of the ear at the maxillary articulation. The swelling around the ear became larger, very painful and tender, especially in front of the ear. The patient could open her mouth at this time and had no pain when moving the jaw. One week later the left ear began to discharge pus very freely and she also had a very bad diarrhea. She was very ill and had a high (?) temperature. The pain was so severe that in her delirium she pulled out her hair on that side of the head. The swelling around the ear increased in size and extent until the whole side of the face was involved and discolored. Five weeks after the abscesses formed she was operated on (April 21, 1908). The abscess in front of the ear and the one into the maxillary articulation were opened and drained and

the mastoid operation was performed. The wound into the maxillary articulation drained for two weeks; that in front of the ear continued to discharge pus for three months after the operation. The mastoid wound discharged pus for six months, during which time four operations were performed, more bone being removed each time. Following the last operation in October, 1908, the wound closed rapidly.

April 28, 1908, one week after the abscesses were opened, the mother noticed that the baby could not open her mouth more than she can at present. The fixation has remained in spite of repeated attempts at stretching.

FIG. 26

FIG. 27

FIG. 26 (Case 6).—There was very little deformity in this case, just a slight deviation of the chin to the left.

FIG. 27 (Case 6).—Extent to which the patient could open her mouth before operation.

Examination. There was not much deformity in this case (Fig. 26). There was a little fulness on the left side of the face and a slight flattening on the right. The chin was almost in the median line and only slightly retracted. The mouth could not be opened more than one-eighth inch (Fig. 27). The röntgenogram (Fig. 28) of the left side of the face showed entire obliteration of the temporomandibular articulation. Comparing this with the röntgenogram of the right side (Fig. 29), the difference between the two was quickly noted. Diagnosis: Bony ankylosis of the left temporomandibular articulation.

Operation. July 12, 1913, the left temporomandibular articulation and the temporal muscle were exposed by means of the

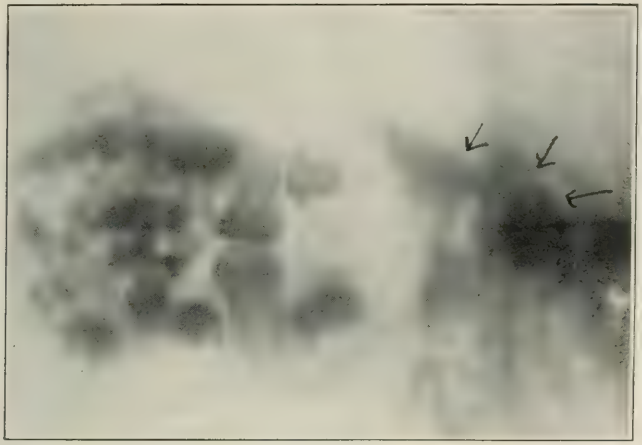

FIG. 28 (Case 6).—Röntgenogram of left side of head made before operation, showing complete obliteration of the temporomandibular articulation. Compare with Fig. 29.

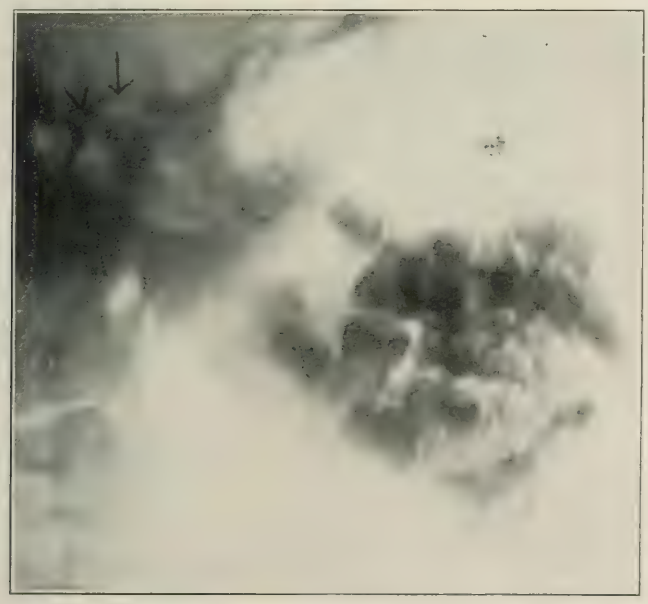

FIG. 29 (Case 6).—Röntgenogram of right side of head made before operation, showing a normal temporomandibular articulation.

L-shaped incision used in the two previous cases, that is, a horizontal incision extending along the upper border of the zygoma and the perpendicular incision in front of the ear, extending upward into the hair. When the articulation was exposed the diagnosis was confirmed. The ankylosis was freed with the olive-tipped dental burr, as in the previous case. One-third inch of the upper end of the condyle was removed with bone-cutting forceps. As soon as the ankylosis was freed, the jaw dropped down. A flap of temporal fascia and muscle, measuring five-eighths of an inch in width and an inch and a half in length, was elevated from its bed, and dropped down over the zygoma and into the articulation, so as to cover all raw bony surfaces. Two catgut sutures placed at the basal angles of the flap secured its fixation. The wound was closed in the usual manner.

Result. The following morning the patient had motion in the jaw, being able to separate the teeth for about half an inch. She was given the wooden wedge to use and when the stitches were removed on the tenth day, she was able to open her mouth for an inch. The wound had healed by primary union, but there was a slight collection of fluid underneath the skin above the zygoma. Three days later when the second dressing was done this fluid was removed by aspiration. It was a dark-colored, clear, odorless fluid, the result of oozing. The fluid did not reform and the patient left the hospital fifteen days after the operation. She was able to open her mouth fully an inch. She returned for examination on the twenty-second day. She could open her mouth easily for a distance of more than an inch and a quarter (Fig. 30). A photograph received six months after the operation shows that she has perfect use of her jaws (Fig. 31).

This was one of the three cases in this series in which a hematoma developed after the operation. The hemorrhage during these operations is very slight, and there is little necessity for ligating bleeding vessels; but I am always very careful to ligate every bleeding-point, because my experience in my arthroplasty work on the larger joints has taught me that that is the safest

procedure, if one would avoid the occurrence of hematomas, which materially hazard the subsequent course of the case.

FIG. 30

FIG. 31

FIG. 30 (Case 6).—Extent to which the patient was able to open her mouth voluntarily, twelve days after the operation.

FIG. 31 (Case 6).—Photograph made six months after operation, showing a splendid spread of the jaws.

CASE 7.—*Ankylosis of Left Temporomandibular Articulation.* L. J., man, aged thirty-one years, was admitted to Mercy Hospital, Oct. 31, 1913, with ankylosis of both hips, all of the vertebral joints, including the occiput to the atlas, the left temporomandibular articulation and partial ankylosis of both shoulders.

In July, 1895, the patient fell from a horse, striking the ground forcibly with the lower end of his spine. He was able to get up immediately and walk, but he had severe pain in the spine. This persisted for several days and then disappeared entirely. In the spring of 1896, he had severe pains in the right hip, the pain coming on slowly and increasing in severity, without any other symptoms referable to the hip. He asserts that he was not subject to tonsillitis or other infections in his nose, mouth, accessory sinuses or elsewhere, either at this time or previously. He consulted a physician, who examined him and discovered a marked scoliosis in the lumbar region. He walked without any support, however, but limped slightly. Some time during 1897, a plaster-of-Paris body-cast was applied to correct the scoliosis. He wore this cast for four years, when a leather jacket

was substituted, and this, too, was worn for four years. During all of this time the right hip became more stiff but less painful. In 1903 he was forced to use a cane, as the right hip was very stiff. In the latter part of 1903 he began to have attacks of pain in the back of the neck, increasing on motion of the head. Finally the neck became stiff, so that he was unable to turn the head in any direction or bend his neck. In March, 1906, the left hip became painful and he was forced to resort to crutches. In June the left temporomandibular joint became affected and gradually power of motion in this joint was lost. The pain disappeared with the loss of motion. In September, 1906, the patient discarded his crutches permanently and not until then did he notice that he could not raise his arm to the full extent. He denied all previous illness, except typhoid at the age of seven; he said that there had been no lues and no Neisserian infection.

Examination. The spine was ankylosed from top to bottom. Both hips were stiff. Motion in the shoulders was restricted in every direction. The lower jaw was absolutely fixed, so that the patient could not open his mouth at all. His head was acutely flexed forward, the chin almost resting on his chest. The conformation of his face indicated clearly that the left temporomandibular articulation was ankylosed. He had had several of his lower teeth extracted, so that he could take food. The right side of the face was flat; the left side was full and round and the lower jaw was slightly retracted.

Operation. November 10, 1913, the usual arthroplasty for this condition was done, except that instead of an attempt being made to separate the ankylosis with the chisel, the neck of the bone was divided, because there was so much new bone formation in the joint that it was feared that if an attempt were made to separate the ankylosis the underlying structures might be injured. Therefore a new joint was made by dividing the neck of the condyle, allowing all of the head to remain in the fossa. The interposing flap was taken from the fat and fascia over the temporal muscle, and because of the sparsity of fat some of the muscle fibers were removed with the flap. The

flap was dropped down over the zygoma into the new joint and tacked with catgut sutures at its basal angles in the usual manner. There was much bleeding in this case and great care was taken to ligate every bleeding-point. The wound was closed as usual.

Result. The first dressing was made, November 22. The wound had healed by primary union and the stitches were removed. There was a considerable hematoma, however, under the skin over the temporal region. Two ounces of a clear, port-wine colored, odorless fluid were removed by aspiration. Microscopic and bacteriologic examination of this fluid was negative. It was aseptic. Two days later another aspiration was made, only half an ounce of fluid being removed. This fluid was likewise negative bacteriologically. The subsequent course of the case was uneventful. The range of motion increased rapidly from half an inch the day following the operation to about three-quarters of an inch on leaving the hospital. The range of motion was limited by the impingement of the chin against the chest. The patient could masticate freely and regarded it as a great pleasure.

Case 8.—*Bony Ankylosis of Right Temporomandibular Articulation.* M. Van W., girl, aged eleven years, was admitted to Mercy Hospital, November 6, 1913, because of inability to open her mouth. When two and one-half years of age she had a very severe illness lasting from five to six weeks. Her father stated that she had had a sore throat and expectorated purulent material. When she recovered, her jaws were stiff, but she could still open her mouth a little. Six months later she had a boil on the back of her left hand, next, one near the left elbow, then one in the left axilla, one on the left side of the neck, and one on the right leg. All of these boils were lanced as they appeared and all discharged pus for a while and then healed. The limitation of motion in the jaw increased in degree until four years ago, when the jaw became absolutely stiff, the teeth being clenched together. The patient is said never to have had any trauma of the face or any other illness except the one mentioned.

Examination. There is absolute ankylosis of the right temporomandibular articulation, bony in type. The right side of the face was full and round, the left side was flattened. The chin was retracted and drawn slightly beyond the midline to the right. There was no motion whatever in the jaw. Diagnosis: Bony ankylosis of the right temporomandibular articulation (Fig. 32).

Operation. November 15, 1913, the usual operation was performed, the joint being exposed by means of the L-shaped incision. The ankylosis involved the head of the condyle. The bones were divided with a narrow, straight chisel in such a

FIG. 32

FIG. 33

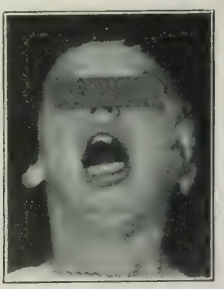

FIG. 32 (Case 8).—The jaw was firmly fixed, and there was the usual gap in the denture for feeding purposes.

FIG. 33 (Case 8).—Front view four months after operation, showing the mouth open to nearly the normal degree and in a perfectly plumb line.

manner as to retain the normal conformation of the joint as much as possible. The gap for the interposing flap was about one-third inch in width. As soon as the ankylosis was divided, the mouth could be opened easily by the anesthetist, although the stiffness of the muscles and ligaments on the other side prevented the lower jaw from falling down. The pedicled flap of fat and fascia was raised from over the temporal muscle. It was an inch and a half long and an inch wide. It was dropped down over the zygoma into the joint and was secured by tacking catgut sutures at its basal angles. The wound was closed in the usual manner.

Result. The following morning, this patient, like all the others, could open her mouth easily more than half an inch. The range of motion increased rapidly and when she left the hospital three weeks after the operation the spread of the jaws measured an inch and a quarter. The wound healed by primary union with no complications. A photograph received from this patient four months after the operation shows a superlatively good result (Fig. 33).

CASE 9.—*Bony Ankylosis of Right Temporomandibular Articulation.* J. S., man, aged twenty-five years, was admitted to Mercy Hospital, November 11, 1913, because of ankylosis of the right temporomandibular joint and the right hip, with a discharging sinus over the right clavicle and another in the right groin. In 1905, after he had been swimming, he had a chill and immediately afterward he noticed a stiffness in the right knee but no pain, redness, or swelling. He does not know whether or not he was subject to an infection in any part of his body at this time, or had sustained a trauma. He was able to use his knee without pain or discomfort. The following morning he was awakened by severe pain in the left knee and on examination he saw that it was red and swollen. A physician was consulted immediately, who made a diagnosis of abscess in the knee and prescribed hot fomentations. The following day the pain in the knee was very severe and the joint was greatly swollen. He had a high (?) fever and became delirious. He was removed to a hospital, the leg was incised in several places and gauze wick drains were inserted. After the operation he was informed that the bone had been drilled into and found necrotic. He remained in the hospital about ten weeks with considerable elevation of temperature, and was delirious most of the time. The left hand and the left side of the neck had also been lanced and several incisions were made on the back along the spinal column. Pus was discharged from every opening. A large bedsore developed over the left hip. When the patient left the hospital (he does not remember when), all the wounds had healed except two in the left leg which were still discharging pus.

Two years later the left leg was amputated in the upper third of the thigh. About one month later he first noticed a stiffness in his jaw, but there was no pain in the temporomandibular joints. Four weeks later an abscess appeared over the left clavicle. It opened spontaneously and discharged pus freely, and, he thinks, some necrotic bone. Abscesses also formed over the right clavicle and in the right axilla, and they, too, opened spontaneously and discharged pus. Finally all wounds healed.

In 1910 he began to have severe pain and swelling in the right arm. An abscess formed, was opened and necrotic bone removed and after a short period of discharge, the wound healed. The right elbow was the next joint to become involved, and when the inflammation in this joint had subsided, he was unable to move it. It was ankylosed. The abscesses in the right groin and over the right clavicle, which are still discharging, developed one year ago.

Examination. The right elbow was firmly ankylosed and flexed to nearly right angles with the arm. The jaw was fixed. The teeth could not be separated even for a fraction of an inch (Fig. 34). The left side of the face was flat. The chin was retracted and drawn slightly to the right of the midline. Diagnosis: Bony ankylosis of the right temporomandibular articulation.

Operation. What the patient most desired was to open his mouth so that he could feed himself. Therefore only the temporomandibular joint was operated on. November 12, 1913, the usual arthroplasty was performed. The joint was exposed through an L-shaped incision. The ankylosis extended across to the tubercle and the usual interposing flap was placed. The wound was closed in the accustomed manner.

Result. The morning after the operation the patient opened his mouth voluntarily about half an inch. The range of motion increased rapidly until at the time of the first dressing, made on the thirteenth day, he could open his mouth nearly an inch. The wound had healed by primary union. About one ounce of a clear, bloody, odorless fluid was removed by aspiration.

Bacteriologic examination proved it to be negative. The stitches were removed on the thirteenth day. When the patient left the hospital, three weeks after operation, he could open his mouth about an inch and a quarter. The patient was seen again April 3, 1914. He could easily open his mouth one and three-eighth inches without the slightest pain or discomfort. Lateral motion of the jaw was perfect and the scar was scarcely discernible (Fig. 35).

The facial nerve, which leaves the skull through the stylo-mastoid foramen, passing forward across the lower portion of the parotid, is distributed to all of the muscles of expression of

FIG. 34

FIG. 35

FIG. 34 (Case 9).—Ankylosis of right temporomandibular joint. The jaw is firmly fixed.

FIG. 35 (Case 9).—Four months after the operation the patient could easily open the mouth one and three-eighth inches.

the face, and there is danger of injuring that nerve and getting a permanent paralysis of these muscles, particularly the fibers that pass to the temporal and supra-orbital zones. These can all be avoided by the L-shaped incision above the zygomatic level.

There is another element of danger connected with this work, namely, one cannot divide the ankylosis in the line of the original articulation, because if he does he is almost certain to penetrate the base of the skull. Therefore, I always remove the condyle of the inferior maxilla, and do not clean out the glenoid fossa to make a cavity.

The location of the internal maxillary artery must always be borne in mind in the removal of bone, as it hugs the neck on the inner side closely and can easily be injured. If it is injured, it should be ligated at the bifurcation of the external carotid. The importance of making the incision above the level of the zygoma can be recognized at once, as it puts the scar-line beneath the hair.

The after-treatment is very important. Mastication should be started at the end of two weeks, preferably not earlier, because otherwise too much fibrous tissue will be produced between the ends of the divided bones. The wooden block (Fig. 2, *E*) should be placed between the molars on the operated side and kept there day and night for two weeks, to prevent possible compression necrosis of the interposing flap. The jaw should not be spread at the time of the operation, as that lessens the effectiveness of the interdental block in protecting the flap.

In all my arthroplasty work there is no operation that gives the same satisfaction to the patients as that for ankylosis of the temporomandibular articulation.

DISCUSSION

Professor Lexer, Jena (by invitation).

I believe in ankylosis of the jaw the prognosis for arthroplasty is good. I have performed the operation similar to Murphy's, but undertook the interposition of free fat flaps. In the other joints I transplanted fat, fascia, and joint cartilage. The most difficult is the knee-joint, because it must be able to support the weight of the body without other assistance. For this reason I here prefer the free homoplastic joint transplant. Concerning the value of this joint transplant one will only be able to judge after a longer experience with it. The joints remain flexible, will support sufficient weight, even though the cartilages change as in arthritis deformans. The technique has been much improved as a result of our previous experiences (thin transplant of cartilage, removal of the periosteum in excision of the synostosis, weight extension after operation, etc.), so that with this free complete joint transplant one has a very promising operation at his disposal. But also other transplants lead to the same end, namely fat in weight-bearing joints. Murphy shows excellent results on the knee, just as other experimenters have shown who have advanced a number of other methods. The most important thing for the joint is good after-treatment of the cases (with well preserved musculature, retained fascia lata, sound patella) and the cure of the underlying cause.

Dr. Jurasz, Leipsic (by invitation).

In the clinic of Professor Payr, in Leipsic, there is big material in ankylosis of joints, and we have gained a good experience in operating these cases. As is well-known, the most difficult joint to operate is the knee, and we had of twenty-three cases after the immobilization sixteen good results and seven failures, the latter all belonging to the early period. Prof. Payr, who had operated the cases, has tried different material, fascia alone, free fascia with fat, and pedicled fascia with fat; the latter is considered to be the best and we use it always; all the last cases have been successful. We consider a good result in a knee-joint to mean movement of at least 50 per cent., so that the patient can sit down and go up stairs. Among our patients have been officers of the army, who could take up their duty in the army after operation and who have been able to ride on horseback up to six hours a day.

We have learned from our experience that we must be careful in choosing cases, many people having no energy, which is required in

the after-treatment. We have to prepare the patients, giving them a good massage to reinforce the muscles, also we must not take patients who have ankylosis as the result of an accident, who are claiming money, because these cases never give good results.

To gain entrance to the knee-joint Prof. Payr is using now the two lateral incisions. Formerly he used sometimes a curved incision and excised the tuberosity of the tibia, in a wedge-shape, a method which has been used by Kirschner, but we found in the course of our experiences that the edges of this piece of bone became partly absorbed so that after the beginning excellent result the piece becomes loose. To prevent the hematoma, which we fear mostly at the beginning, and which early gives rise to ankylosis, we put the knee-joint on a splint for the first two days and bandage tightly, and only from the third day we begin with extension; we practice early good massage of the muscles and passive movements.

Dr. Edward Martin, Philadelphia.

In all fairness to the fair Philadelphian who left Dr. Murphy for me, it is only fair to state that this action was due not to mental deficiency, but to traumatic conditions and ease of access. The girl had been operated on thirteen times for an ankylosis of the right side of the jaw without any large measure of success. There was complete fixation. The condition was one of emergency, since the regular molar tooth was giving trouble and could not be reached by the dentist, since her teeth were tightly clenched together. An incision was made directly in front of the ear, the soft parts, including the branch of the facial nerve, stripped up from the zygoma and the coranoid process and the vertebrine sphenoid. The coranoid process is elongated by a bony growth which is continuous with the sphenoid, there being thus formed a spur which was chiseled and cut away, about an inch of bone being removed. There was complete restoration of function, not immediate because the contracted masseter muscles prevented this. The multiple operations preceding the last one really constituted an extremely interesting experimental demonstration of the possibility of causing a bony growth by teasing, tearing, and wounding the periosteum. By the scars left by my predecessors I assumed that something was cut, and from the description of the mother I learned that the jaw was then forced open by wedges and levers, as much power being applied as the surgeon believed the bones would stand without breaking. These recurring traumatisms resulted in an ossifying periostitis which firmly united the lower jaw to the base of the skull.

Dr. John B. Murphy, Chicago (in closing).

There are two points I wish to emphasize: first, the fact that passive motion should not be resorted to until the wound is healed. This means that both the internal and the external wound must be healed. Torad passive motion encourages internal bleeding, with formation of connective tissue and subsequent fixation. We put on extension immediately after operation, in fact, in the hip cases the extension is put on before operation. In the jaw we place a plug between the two alveolar processes and maintain this until primary union. The hematoma is one of the greatest and most difficult obstacles to a good result. We resort to aspiration as soon as it is recognized, and repeat that until the bleeding ceases, and there is primary or secondary approximation without suppuration in the two surfaces of the wound. If a clot has organized beneath the skin, we remove a few stitches, and with a sharp curette excavate the clot and re-approximate the wound edges with Machelle clips.

CANCER OF THE TONGUE BASED UPON THE STUDY OF OVER ONE HUNDRED CASES. PRELIMINARY REPORT[1]

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This study has led to some very remarkable conclusions.

It has been demonstrated that the failure to cure when cancer of the tongue is fully developed is due chiefly to the neglect to remove the muscles of the floor of the mouth below the cancer.

The high mortality after operations for cancer of the tongue is chiefly due to the removal of the floor of the mouth without removing a section of the lower jaw.

The investigation has also shown that if a lesion of the tongue is subjected to immediate operation within a few weeks after the onset of the lesion, the chances of a permanent cure are best. In this stage it will usually be sufficient to remove the local lesion with a good margin of healthy tissue, and this removal should be done with the electric cautery. The centre of the lesion should be preserved for microscopic study. When this is done, the chances are that the lesion will still be benign. But even though the lesion prove microscopically cancer, the probabilities of a cure are almost 100 per cent.

In the past surgeons have apparently removed too much of the tongue and have performed too extensive operations upon the glands of the neck. Now, this is theoretically incorrect, because cancer of the tongue infiltrates into the glands of the neck through the floor of the mouth. Should the glands be involved and the floor of the mouth not be removed, one could hope for little, if

[1] Abstract only.

anything, from such an operation. If the glands of the neck are not involved, this does not preclude infiltration of the floor of the mouth.

When the operation is performed in one stage it is impossible to remove the tongue, the floor of the mouth, and the glands, and then to close the opening in the mouth, unless a section of the lower jaw is also removed. If the former operation is done thoroughly, the mortality is very high—almost 80 per cent.—from primary or secondary pneumonia, or a late infection from the oral fistula.

The author was first impressed with these facts when it was found that the first cured cases were either cancers originating in the floor of the mouth, or cancers of the tongue invading the floor of the mouth in which it was absolutely necessary to resect portions of the lower jaw in order to remove the disease. The extent of the disease, therefore, forced the surgeon to the more radical and mutilating procedure, and allowed him to perform removal *en bloc*. During the same period earlier and more favorable cases were subjected to less extensive operations. When the floor of the mouth was not removed local recurrence always followed, and when it was thoroughly removed the patients died from the operation.

The author in November, 1910, for the first time deliberately, in a favorable and early cancer of the tongue, removed the right half of the tongue, the right floor of the mouth, the right half of the lower jaw, and the glands on the right side of the neck in one piece. The wound was closed by suturing the mucous membrane of the right cheek to the remaining half of the tongue. The patient swallowed at once after the operation, and no recurrence followed. The microscopic study showed that the floor of the mouth was infiltrated, but the glands were free.

As the removal of the lower jaw, especially in the region of the symphysis, is mutilating, the author has attempted to accomplish the same results in a different way.

The glands of the neck are first removed and, after the operation, their connection with the floor of the mouth below the lesion

is thoroughly burned with the cautery and the wound closed. Then the lesion in the tongue or floor of the mouth is attacked with the electric cautery. The application of this is usually repeated two or more times, until everything is destroyed down to the area of the first cauterization from below. The healed skin flap of the first operation forms the floor of the mouth and prevents an oral fistula.

The first operation after this method was performed in April, 1912—two years ago. The lesion was a cancer occupying the floor of the mouth between the tongue and the symphysis of the jaw. It was about the size of a silver dollar. Permanent cures have been accomplished in similar cases by *en bloc* dissection of tongue, floor of the mouth, jaw, and glands. The oldest case lived fifteen years, but this is a very mutilating operation, and the recent patient refused to submit to it. This led the author to attempt what he had had in mind for some years. At the present writing—two years since operation—there is no evidence of recurrence and no mutilation.

Since then four cases have received this treatment with, so far, apparent success.

The majority of cases of cancer of the tongue seek surgical aid at an unnecessarily late period. In every case the patient is warned. There is always something to be seen and felt in the tongue or floor of the mouth. If such a lesion is investigated at once, a local operation with the electric cautery should be sufficient; in a little later stage removal of the glands and repeated cauterizations in the mouth; in still later stages resection of the jaw must be done. The author's recent experience seems to show that this operation should be done in stages: first, thorough removal of the glands with cauterization of the floor of the mouth from the neck wound; second, cauterization of the lesion within the mouth; third, removal of the lower jaw and cauterization area. These points will be discussed in detail with illustrative cases in the complete paper.

When the cases observed up until 1908—a period of eighteen years—are compared with those observed during the past five

years, the influence of education is well shown. The very early precancerous lesions have increased from 8 to 30 per cent. The late and inoperable cases have decreased from 18 to 10 per cent. The cures have increased from 21 to 50 per cent.

When the author considers the cases personally operated on by him by these newer methods, in the past five years (14 cases in all) he finds that there has been no postoperative mortality, and so far but one patient is dead of recurrent carcinoma. In this case the lesion of the tongue had previously been subjected to operation, the recurrent tumor was extensive, and the glands of the neck involved. In this group every type of operation according to the newer methods just described is represented. At the present time there is evidence of recurrence in only one case, here the lesion was most extensive and the operation most radical.

The experience with these 14 cases prove the point as far as the immediate mortality is concerned, because considering all cases studied the postoperative mortality has been about 22 per cent. Since recurrences as a rule, take place within one year of the operation, the results in these 14 cases also demonstrate that the improved methods promise a much larger percentage of permanent cures, and certainly a longer freedom from recurrence.

We have, therefore, apparently conquered the technique of operations for cancer of the tongue. Now, if we can educate men to come earlier, we shall probably conquer the disease.

COMPARATIVE TABLE OF RESULTS IN CANCER OF THE TONGUE AS ASCERTAINED IN 1908 AND 1913 IN THE SURGICAL PATHOLOGICAL LABORATORY OF THE JOHNS HOPKINS HOSPITAL AND UNIVERSITY.

	Totals.	1908.	1913.
All cases	100	70	30
Benign lesions	15	6 = 8%	9 = 30%
Malignant warts	4	3	1
Cancer	81	61	20
Inoperable	13	11 = 18%	2 = 10%
Postoperative deaths	15	11 = 22%	4 = 22%
Lost track of	18	15	2
Cured	11	5	6
Out of cases	36	24	12
Percentage	30	21	50

This table demonstrates that the local propaganda of education has increased the very early benign lesions from 8 to 30 per cent. In this stage 100 per cent. of cures are always accomplished by proper treatment—the excision of the local area of the tongue under local anesthesia—a simple, painless operation.

The four cases of malignant warts have been cured. These represent the earliest stage of cancer. The operation necessary to cure is the same as for the benign lesions.

The inoperable, hopeless cases have been decreased from 18 per cent. to 10 per cent. This, of course, is still too large.

The postoperative deaths remain the same—about 22 per cent. These deaths, however, have only occurred after the most extensive operations for cancer in its very late stages and are the direct result of delay on the part of the patient.

The cures have increased from 21 per cent. to 50 per cent. The improvement is really greater, because in the 1908 cases 15 cases have been lost track of, while in the 1913 cases only 2 cases were not traced.

This great improvement in the number of cures is due chiefly to the education of certain individuals to seek advice very quickly after the first appearance of the lesion on the tongue.

The operation in the early stage of cancer of the tongue not only promises a larger probability of a cure, but the necessary operation is less dangerous and involves practically no mutilation.

The only hope of accomplishing cures in the later stages of cancer of the tongue rests upon the removal of a piece of the lower jaw. This operation has an element of danger and is mutilating.

One week's delay after the first appearance of a lesion on the tongue involves a greater risk than three months' delay for a similar lesion on the lower lip, and one year's delay for a similar lesion on the skin of the face or body.

There is absolutely no reason for this delay, if the people but understood the situation.

The chief irritating factors in cancer of the tongue are burns from smoking, irritation and wounds from teeth, syphilitic ulcers, and the irritation of chewing snuff by mouth.

The moment an individual notices any lesions on the tongue, floor of the mouth, or mucous membrane of the oral cavity, or little white patches, tobacco should be discontinued at once, the teeth should be put in absolute order, there should be a Wassermann test made for syphilis, and if this is positive immediate treatment with salvarsan. If the little lesion does not heal within two weeks, it should be excised by a competent surgeon.

With the knowledge of these facts none should fear death from cancer of the tongue, nor the operation for its cure, nor mutilation.

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Can it Be Proved from Clinical and Pathological Records that the Number of Cures of Cancer Will Be Greatly Increased by the Proper Excision in the Earliest Precancerous or Cancerous Stage of the Local Disease?

American Journal of the Medical Sciences, January, 1914, cxlvii, 76.

Read before the American Association for Cancer Research, Washington D. C., May, 1913.

DISCUSSION

Dr. Morestin, Paris (by invitation).

Cancer of the tongue is too often operated on too late. Frequently, moreover, the extirpation is performed in too summary a manner. It is for this reason that the results of surgical intervention are too often so little satisfactory, but cancer of the tongue will lose its bad reputation when we shall have pursued the plan of applying systematically to lesions of very little extent very extensive operations, and shall have performed those with a technique very minute, very precise, including the extirpation of all the diseased and suspected tissues, and especially the extirpation of all the threatened cervical glands. To accomplish this it is necessary to do regular dissection, such as for a demonstration in anatomy. For this reason we have called the proceeding the "anatomical method" or "anatomical procedure."

The operation comprises two stages: (1) cervical, having for its object the clearing out of the regions that harbor the glands, and (2) that of excising the tumor with the half of the tongue corresponding, or else with the whole tongue.

If we suppose a typical case, in which the cancer occupies one of the sides of the tongue, having originated at the height of the last molar tooth, this is the way I habitually proceed:

I trace on the outside three large incisions which diverge, starting from a single point situated at the height of the hyoid bone or of the superior margin of the thyroid cartilage, and which extend, one toward the apophysis of the mastoid, the other toward the chin, the third toward the supraclavicular fossa. The whole may be compared to a star with three branches, and it is for this reason that I have designated it as the stellate incision. The flaps outlined by these incisions are dissected out and separated, and one can then successively attack the various ganglion regions. I prepare successively the supraclavicular region, the carotid, the submaxillary, dissecting very close to all the organs and especially to the vessels. The glands are not extirpated singly but *en masse*, leaving them in their surroundings of cellular tissue. The very complete cleaning out of the ganglionic regions being completed, I close the carotid region by suturing the anterior edge of the sternomastoid to the posterior belly of the digastric and to the subhyoid muscles. This is a detail of technique to which I attach great importance. Thanks to this suture the dangerous carotid region and the supraclavicular fossa will later be protected from infection. We then pass to the buccal cavity. In the supposed

case, cancer being still limited to one side of the tongue, I extirpate the half of that organ corresponding from the floor of the mouth to the level of the hyoid bone. I even habitually remove the tonsil and the parts adjacent to the pharyngeal wall, because certain lymphatics of the tongue cross the pharyngeal wall in this region. Hemostasis is accomplished by suturing the different layers of the wound; then I reunite hermetically the cutaneous wound to avoid the formation of fistulæ. The buccal submaxillary wound is packed with antiseptic gauze and the ligaments are united and sutured on top of this packing, which will later be removed through the mouth. For a month the invalid is fed by a tube. Naturally the operation will be somewhat different if the tumor has infiltrated the depths of the organ. If it reaches or goes beyond the median plane, if it has originated at a level with the base of the tongue, or if it has invaded the jaw, one will then be obliged to remove the whole of the tongue, extirpate and clean out the glands bilaterally, and resect part of the jaw. In this respect I think one should make every effort not to sacrifice any part of the lower jaw that is not absolutely necessary. One can often confine one's self to a partial resection, not taking in the whole depth of the bone. By extirpating only the alveolar portion and preserving the lower part one will often perform just as useful and just as curative an operation and one much less mutilating. The diminution of the immediate mortality is obtained:

1. By the reduction of the general anesthesia.

2. By closure of the carotid region and safeguarding it from buccal infection.

3. By precautions taken to prevent as much as possible the swallowing of blood.

4. By the care in feeding the patient exclusively by means of the esophageal tube.

5. By the diminution of the period of confinement to bed; the patients are allowed to get up on the very day, or at least on the day after operation.

As to the prognosis for the future, it depends almost exclusively upon the time at which one has performed the very wide excision and the eradication of the lymphatic channels and glands. It is doubtful or poor if the intervention has been tardy, but it is very favorable when by good fortune it has been early.

Dr. Charles H. Mayo, Rochester, Minnesota.

I wish to say that I was glad to hear Dr. Bloodgood speak of heat in the treatment of these cases. The Paquelin cautery is not a satis-

factory means, since it is too hot. The crusting that ensues from frying the blood on the white-heated instrument prevents the heat from reaching the distant tissues by making carbon, which is better than asbestos in preventing heat penetration. The heat, then, must not be too hot. The electric heat or the dull actual cautery broils and does not cut tissue. The time of application should cover many minutes to get heat penetration, thus broiling but not frying the tissues.

Dr. Joseph C. Bloodgood, Baltimore (in closing).

The point I want to make is that we can express ourselves in regard to cancer in this way: that in most regions where cancer comes we have conquered the technique, it is simply now a question of conquering the disease. No one will doubt that we have conquered the technique of resection of the stomach, but we do not cure all cases of cancer of the stomach. But there is one locality, cancer of the tongue, where the technique is not conquered, for different men advise different procedures in different years, so they have not come to a definite method yet. I make this suggestion because up to the present time it has no mortality, but that is not the only thing; it has accomplished results which no one in Baltimore, at least, has accomplished before.

THE FUNCTION OF THE GASTRO-ENTEROSTOMY OPENING IN CASES OF PERMEABLE PYLORUS

BY HENRI HARTMANN, M.D.
PARIS

WHAT becomes of the gastrojejunal mouth and how does it work in case of a permeable pylorus? Such are the two points to which I wish to draw attention.

I. *Does the Gastro-intestinal Mouth Obliterate Anatomically in Case of Patulous Pylorus?* Kelling,[1] in Germany, suggested that in cases where the pylorus is free, the gastro-intestinal opening might be subject to anatomical obliteration in consequence of the fact that the chyme passes through the pylorus and does not pass through the artificial opening. His opinion has been accepted in France by Tuffier,[2] Beynier,[3] Jaboulay,[4] Mathieu,[5] Bicard,[6] and is almost general.

Personally, I disagree with this opinion, unwilling to admit that the anastomosis, thoroughly lined by a mucous membrane and free from any scar tissue, should become obliterated merely because of its uselessness. This would be against all the rules of general pathology.

When we refer to the cases of anatomical obliteration of the gastro-intestinal anastomosis, we see that these obliterations are in no way connected with the permeability of the pylorus.

In 44 cases of anatomical obliteration of the gastro-intestinal mouth, which we gathered in literature, we only found 4 cases of permeable pylorus. In 7 cases the cause of obliteration has been undoubtedly the secondary development and the cicatrizing of a peptic ulcer of the gastrojejunal mouth (Kauffmann,[7] Keulein,[8] Navarro,[9] Gosset,[9] Leriche,[9] Oviatt[10]). In the 34 other cases the mechanism of the obliteration appears less distinctly. We observe, however, that in 23 cases buttons

were used (Bicard[11] 1 case, Czerny[12] 4, Ettlinger[13] 1, Feldmann[14] 1, Ferrari[15] 2, Jaboulay[4] 1, Kehr[16] 1, Leriche[17] 1, W. Mayo[18] 4, Moynihan[19] 2, Schloffer[20] 5), that in 4 cases sutures were used (Eiselsberg,[21] Hartmann, Bicard, Tuffier), and that in 3 cases Y-shaped gastro-enterostomy was performed (Fedoroff,[22] Marprofit, Roux). In the last 4 cases technical details are lacking.

Briefly then:

1. The obliteration of the gastro-intestinal mouth is in no way connected with the more or less permeability of the pylorus.

2. Undoubtedly the obliteration results sometimes from the cicatrization of a peptic ulcer having developed itself in the mouth.

3. The technique used has a direct bearing on the result. Obliteration of the anastomosis is exceptional in cases not operated with button or by the Y-method. On the other hand, the integrity of the anastomosis has been anatomically ascertained in cases of functionless pylorus by Henck[29] after three months, by Schenen[26] after twenty-eight months, by Busch[25] after six years, by myself after five years.

II. *Are the Gastro-intestinal Anastomoses Functionally Useless in Cases of Permeable Pylorus?* In 1908, after summarizing the experiments made by Blake and Cannon, Leggett and Maury, Kelling, Debbet, Tuffier, adding to these experiments some radioscopic examinations on men, two observations of duodenal fistula by Berg, in which all the gastric contents passed through the fistula notwithstanding a gastro-enterostomy, Guibe[26] concludes: "All the experiments on animals and observations on men seem to agree sufficiently to prove that as long as the pylorus remains permeable, the stomach has an almost invincible tendency to drive out its content through this orifice without being inclined to utilize the artificial mouth. Nothing whatever passes through the new opening; on the contrary, everything passes through the pylorus."

This opinion, clearly expressed, may be considered as generally accepted, even up to this day.

However, when we read the reports of the radiologists, we see that the facts do not agree absolutely with these conclusions. Leguen[27] observes that in a case of permeable pylorus all the gastric contents pass through the mouth. Bicard and Debbet[28] have shown us that the gastric contents pass as well through the mouth and through the pylorus. Pess,[29] after having studied 40 gastro-enterostomies by the *x*-rays, comes to the conclusion that the stomach (its pylorus being permeable or not before the operation) empties itself continually by the mouth and by the pylorus. Gray,[30] in a case of ulcer without stenosis, finds that the gastric contents pass specially through the mouth. Petrév[31] examined 9 cases of gastro-enterostomy for gastric lesion with integrity of the pylorus; four times all the gastric contents passed through the mouth, twice through the pylorus, three times through the pylorus and through the anastomosis. In 4 cases of normal pylorus, Härtel[32] finds that the evacuation takes place as well through the pylorus as through the mouth (1 case two years, and 1 seven years after operation). Hesse[33] finds in 9 patients that the gastric contents pass through the mouth and through the pylorus.

These quotations prove sufficiently that the opinion of those who affirm the functional uselessness of the gastro-enterostomy in cases of permeable pylorus is not as exact as they suppose, and that it is necessary to modify their too absolute affirmation.

To elucidate the question, I have made two kinds of researches:

1. Experiments on dogs.
2. Radiological examinations of patients.

EXPERIMENTS ON DOGS (IN COLLABORATION WITH MY PUPIL, M. MÉTIVET)

Dog 1.—Gastro-enterostomy joining the terminal portion of small intestine and pyloric antrum. Section of the intestine above the anastomosis suturing its proximal end to the skin, closing its distal end.

The dog lived thirteen days without expelling any feces through

the rectum. We supposed that the anastomosis had not acted. At the postmortem we found a stomach containing intestinal fluid, the efferent portion of the intestine being empty, and numerous adhesions at the point of the anastomosis. The fluid introduced into the stomach passed with much difficulty through the mouth.

Dog 2.—Gastro-enterostomy between the initial portion of small intestine and the fundus of the stomach. Thirty-seven days later the dog is vomiting intestinal liquid and shows all the symptoms of intestinal obstruction. Next day we gave it 300 gr. of milk and half an hour later we killed it. At the post-mortem the stomach contained a yellowish fluid of fecal odor with clots of milk. This did not pass either into the duodenum, or into the jejunum. The mouth was anatomically in good condition but obliterated by a bone which stayed behind in its aperture and obstructed, on the other hand, the intestine. The intestine was extended by the liquid reaching the point of anastomosis and was retracted just behind the anastomosis.

Dog 3.—Gastro-enterostomy between the initial portion of the jejunum and pyloric antrum. Forty-four days after the operation the intestine is cut just above the anastomosis. The end in connection with the anastomosis is closed and the duodenal end is fixed to the skin.

The next day a meal composed of milk and hashed meat is given to the dog, which it eats with good appetite. After seven or eight minutes some bile is coming out of the duodenojejunal opening and fifteen minutes afterward a few small curds of milk mixed with the bile. Half an hour after the meal the dog is killed. In the doudenum some bile and a few curds of milk are found representing what has passed through the pylorus. In the jejunum, at a distance of about 65 to 70 cm. one perceives a quantity of clots of milk and some particles of meat, showing what has passed through the gastro-intestinal mouth, which is normal, the pylorus likewise.

Dog 4.—Gastro-enterostomy between the initial portion of the jejunum and the pyloric antrum. Forty-six days after the

operation, the intestine was cut above the anastomosis, exactly like the former cases, the end attached to the stomach was closed, and the duodenum fixed to the skin.

After three days, 400 gr. of milk were given, 10 minutes later, drainage through the duodenal fistula. The animal was killed twenty minutes later. In the duodenum we found some curds of milk which had passed through the pylorus. In the jejunum, for a distance of more than 1 meter, the intestine was full of curds of milk. Artificial opening and pylorus both normal.

Dog 5.—Gastro-enterostomy between the jejunum and fundus of the stomach. After a month, section of the intestine above the anastomosis, closing the gastric end and fixing the duodenal end to the skin.

The next day 400 gr. of milk and hashed meat is given to the dog. After two and a half minutes, milk began to flow abundantly through the duodenal opening, mixed with a few particles of meat. Ten minutes later about 150 gr. of milk are flowing. The animal is killed 10 minutes after the meal. We find in the duodenum a great quantity of milk and particles of meat which passed through the pylorus. In the jejunum at about a distance of 10 to 20 cm. we see some clots of milk and some particles of meat, representing all that had passed through the anastomosis. Artificial opening and pylorus both normal.

Dog 6.—Gastro-enterostomy between the initial portion of the jejunum and the fundus of the stomach. Thirty days after the operation, after having removed an adhesion, which united the anterior part of the stomach with a point of the efferent part of the jejunum, situated 9 cm. below the anastomosis, we cut the intestine across above the anastomosis, closing the gastric end and suturing the duodenal end to the skin.

The next day a meal of milk and hashed meat was given to the dog. Seven minutes later, the milk and some particles of meat were passing through the duodenal aperture. The dog was killed half an hour after the meal. The duodenum contained some curds of milk and some particles of meat; the jejunum contained milk and meat in its first centimeter. Gastro-anastomosis and pylorus both normal.

Dog 7.—Gastro-enterostomy between the initial portion of the jejunum and the pyloric antrum. Two hundred and twenty-three days after the operation; second operation (June 22, 1912). Section of the jejunum above the anastomosis, closing the gastric end and suturing the duodenal end to the skin 20 cm. below the anastomosis; the jejunum is cut through a second time, closing the distal end and fixing the proximal to the skin.

The next day, 100 gr. of milk is given to the dog; one minute later liquid began to flow through the jejunal fistula (corresponding to the anastomosis); two and a half minutes later a large amount of bile is flowing through the duodenal fistula. These liquids are collected and preserved. About a quarter of an hour later the liquid coming from the jejunal fistula is no longer clear, a fresh sample is put aside. These different liquids are analyzed by W. Fabre. During the first quarter of an hour, bile flowed through the duodenal fistula and acid liquid through the duodenal fistula, the jejunal fistula. After a second quarter of an hour bile is coming through the duodenal fistula, giving a liquid-containing ozazone (specific of lactose) which W. Fabre could not find in the bile coming through the duodenal fistula. Next day half a pint of milk is given to the dog. It is killed an hour later. The stomach contains an almost clear liquid with some curds of milk; the duodenum is full of bile and some few curds of milk. The piece of jejunum connected with the gastric mouth is full of curds of milk. The mouth is normal, so is the pylorus.

In none of these experiments did we find the mouth obliterated, nor thickened, even after having kept the dog alive during a long time, 223 days in a case.

As for the functions of the mouth, we may leave aside the Experiments 1 and 2. In the first, function was prevented by adhesions and angulation; in the second, the dog died the thirty-seventh day in consequence of an intestinal occlusion produced by a bone obstructing the mouth and the intestine just in front of it.

In 2 cases, in which the mouth was made on the fundus, the

gastric contents passed at the same time through the mouth and through the pylorus, but the greatest quantity through the latter.

In 3 cases, in which the anastomosis was made on the antrum, 44, 50, and 223 days after the operation, the gastric contents (milk and meat) passed through the artificial mouth almost entirely.

These experiments show that the evacuation is done principally through the anastomosis if it is situated on the pyloric antrum, through the pylorus if it is situated on the fundus of the stomach.

If previous experimentation saw the gastric contents passing almost altogether through the pylorus, it was probably because of their having made the anastomosis on the fundus of the stomach. It is the fundus which presents when opening the abdomen of a dog, and it is this part of the stomach which is brought out. Therefore, it is the natural portion used for anastomosis. The pyloric antrum, on the contrary, is situated deep under the liver and it is necessary to pull it out to bring it to light. It is, therefore, only when one has the fixed intention of making the anastomosis on this part that one is at all likely to do so.

Most probably Kelling, Debbet and Tuffier operated on the cardiac part of the stomach. As for Tuffier,[34] we are quite sure of it. He says: "I remind you how easy it is to observe on a dog, making use of *x*-rays, that everything passes through the pylorus, because we know, when operating on a dog, that the new pylorus can only be placed at a distance of 25 cm. from the normal pylorus and not less."

In the experiments on cats by Cannon and Blake, eight times gastric contents was forced out naturally by peristaltic waves through the pylorus; only two exceptions were observed, food leaving by both exits; in one of these 2 cases the stoma was in the posterior wall of the antrum close to the pylorus, in the other about half-way between the two ends of the stomach.

Calabrene, who paid attention to place the mouth near the

pylorus, notes that the contents of the stomach passes through the anastomosis.

These different modes of evacuation of the gastric contents according to the position of the artificial opening find their explanation in the differences of the muscular contractions in the different zones of the stomach. In order that the gastric contents may pass from the stomach into the intestine, the pressure to which it is subjected must be greater than that of the intestinal contents.

Experiments show us that the pressure, which is very weak in the fundus, gets stronger in the antrum and that even in the latter it is subjected to considerable variations, getting considerably stronger at the very moment of the gastric contractions. Von Pfungen, in 1887, measured intragastric pressure on a boy with a gastric fistula. The pressure in the fundus varied only from 5 to 10 mm.; in the region of the pylorus the pressure was greatly increased and varied from 40 to 80 mm. mercury, in connection with its peristaltic contractions.

Hofmeister and Schutz had observed likewise a very great difference in the form of contractions of the two parts of the stomach, in their experiments on dogs. Moritz has seen, in his observations on men, that as far as the left part of the stomach was concerned, he observed only very rare and slight variations of pressure (from 2 to 6 cm. of water), meanwhile, he found that in the pyloric region the energic contractions of the gastric muscle were very frequent and capable of making the water rise up to 50 cm.

All the investigations agree to make us consider, with Gray and others, that the stomach consists of two parts, the cardiac part acting as a reservoir and the pyloric part as a motor.

One understands, therefore, that the juxtapyloric anastomosis works actively even when the pylorus is normal, and that the anastomosis on the cardiac part is functionless in cases of permeable pylorus.

Radiological Examinations (in collaboration with Dr. Maingot, radiographer of the Loumec Hospital, and Wolfram, junior

demonstrator in anatomy). The radiological examinations on man have confirmed the results of the experiments on dogs. Our anastomoses have almost always been placed on the lowest part of the pyloric antrum. In consequence, we observed that the evacuation of the gastric contents takes place partly through the anastomosis, partly through the pylorus.

To be quite certain of the exact point of passage of the bismuth, the examination of a skiagram is insufficient. In cases where the bismuth has passed through the pylorus, it happens that the skiagram shows a loop leaving the greater curvature and giving the illusion of a passage through a gastro-intestinal anastomosis, whereas this appearance is due to the fact that the initial portion of the duodenum is overshadowed by the stomach, the jejunal shadow only separating from that of the stomach below the greater curvature. It is indispensable to make a skiascopic examination. One then sees the bismuth pouring into the stomach and passing through the anastomosis before reaching the pylorus. In this way it is impossible to mistake the evacuation through the anastomosis for an evacuation through the pylorus.

The evacuation through the anastomosis does not always take place in the same way: On 19 of our patients, without a sign of gastric stasis before the operation and no sign of pyloric stenosis during the operation, we observed after intervals varying from one to eleven years:

Once, everything passed through the pylorus; 511 times everything passed through the anastomosis; seven times the bismuth passed both through the anastomosis and the pylorus.

Sometimes the passage was almost immediate; in other cases the passage took place by instalments, succeeding each other at short or long intervals; in some cases the evacuation began with a gush and continued by repeated instalments.

The results of radioscopic examinations are therefore in accordance with the results of the experiments and show that, in opposition to the general opinion, the gastro-intestinal anastomosis may work even in cases where the pylorus is patulous.

We have found these results interesting enough to draw your attention to them even if they have not considerable practical importance and if they do not prevent many surgeons from continuing to exclude in many cases the pylorus.

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DISCUSSION

Dr. J. M. T. Finney, Baltimore.

Prof. Hartmann's paper is most interesting and most suggestive. I always hesitate to discuss a paper on gastro-enterostomy because I am willing to admit prejudice to start with. My own feeling about the operation is that it should never be the operation of choice, only an operation of necessity.

I have been particularly interested in the two diagrams on the board, because they both illustrate very beautifully my own observations in this matter. In the first place, for some years past in connection with Dr. Baetjer and Dr. Brown, I have studied as far as possible all cases of gastro-enterostomy with this idea in view, namely, of determining the subsequent function of the new opening in cases where the pylorus was patent. Professor Hartmann's observations are in entire accord with my own. It is never my practice to close the pylorus in doing gastro-enterostomy. It has never seemed to be necessary for the reason mentioned. In many of the cases examined years afterwards the new opening did not close in the presence of a patent pylorus; and in the second place, where it was patent it functionated or not as the case may be. The explanation given by Professor Hartmann is one that had not occurred to me, but which seems very rational. The fact remains that it did not appear necessary to close the pylorus at the time of gastro-enterostomy. The second point, namely, that the x-rays are deceptive, is certainly well taken. The more I study *x*-rays in connection with stomach cases the less absolute dependence do I place in them. If the *x*-rays agree with the clinical picture, then I accept it as positive corroborative evidence. If, as sometimes happened, it is opposed to the clinical picture, I have always followed the clinical picture and have, as a rule, found that that was the correct course. Occasionally there were exceptions, but it seems to me that in perhaps 60 per cent. or less of the cases where we have been able to study the case thoroughly with the use of *x*-rays and the clinical history, and then check it up by operation, have I found the *x*-rays dependable.

This paper is certainly a most instructive one, and one which I think will bear a good deal of fruit. There is one point in addition that seems to controvert the well-established idea, namely, that in the face of a closed pylorus the new opening will never close. That is not true. A case came under my notice recently, operated on by Dr. Gerster, which statement is sufficient evidence that the operation was well done in the beginning. He had had a posterior gastro-enteros-

tomy done for an obstructed pylorus due to scar tissue. For nearly five years that opening functionated satisfactorily. Then he came under my care with symptoms of almost complete obstruction. I operated and found that the pylorus was absolutely obliterated. The specimen was carefully examined after removal, and I found no sign that there had ever been a pylorus. I did not believe it possible for the pylorus to become so completely obliterated. The mucous membrane had been completely restored. The new opening was not larger than a straw, just admitting a little fluid. That shows that it is possible for the new opening to close in the face of a closed pylorus. I call attention to this fact, as the reverse of it is quite the prevalent idea.

Dr. Arpad G. Gerster, New York.

I wish to add one point regarding this interesting observation of Dr. Finney's which he omitted, but which I consider important. The operation was done with the aid of the Murphy button and the very observation given by Dr. Finney has been repeated by me in a number of other cases operated on ten years or more years ago, when the Murphy button was more frequently used. When these apertures were inadequate, and when a peptic ulcer developed, as Dr. Hartmann suggests, along the juncture of stomach and jejunum, the inadequate aperture closes more promptly and rapidly than where an ample stoma was established.

Dr. F. B. Lund, Boston.

As confirming Prof. Hartmann's observation, I wish to report a case of a woman on whom I did a gastro-enterostomy for an extensive indurated ulcer of the lesser curvature. Four years later, having occasion to remove a fibroid, I found the pylorus and the gastro-enterostomy wound open. The ulcer had entirely disappeared and the woman was in perfect health so far as her stomach was concerned. The fact that in patients who have made a good recovery after gastro-enterostomy, the *x*-rays show sometimes the opening through the pylorus and sometimes through the stoma, indicates that closure of the pylorus is not always necessary to secure a good result in gastro-enterostomy.

In connection with Dr. Finney's remarks I wish to report a case illustrating the value of his gastroduodenostomy where gastro-enterostomy has failed. I saw last summer a patient, aged seventy-three years, upon whom Dr. Weir had performed a gastro-enterostomy ten years before on account of pyloric ulcer. The patient was in

poor condition and the Murphy button was used as the quickest method. A large button united the small intestine to the stomach. Entero-enterostomy was performed with a small button. The patient passed the large button and one-half of the intestinal button. When I saw him he had a greatly dilated stomach and visible peristalsis. The pylorus was greatly contracted, and half of the intestinal button was in the stomach and blocking the pylorus. It was evident that this half of the button had passed back into the stomach and later the gastro-enterostomy opening had contracted. It would have been difficult to have enlarged the old gastro-enterostomy opening on account of adhesions; therefore the button was removed and Finney's pyloroplasty performed, with complete relief of the symptoms. It seems to me that this procedure is applicable to a considerable number of cases, may well be employed where gastro-enterostomy has failed, and probably has a wider application in fresh cases than has been generally believed.

Dr. John Bapst Blake, Boston.

In Dr. Hartmann's admirable paper he spoke of the monograph by Prof. Cannon, in which I did the operative work on cats. At that time I would say that it was believed that if you made a new opening into the stomach at whatever point the food would pass through that opening, the stomach being considered a paper bag draining from its most dependent portion. Dr. Cannon's observations discounted that immediately; in our conclusions, however, we did not state that food would invariably pass out through the pylorus but that the physiological tendency was that the food would pass through the pylorus; it was created to take care of the passage of food from the stomach, the musculature being so arranged as to tend to close every artificial opening. Our second observation agreed with Dr. Hartmann's of the inefficiency of a stoma in the cardiac end of the stomach. Dr. Cannon pointed out at the time that the stomach consisted of one part as receptacle, the cardia, and the distal portion as a discharging cylinder. The nearer the cardia the less efficient the stoma. The larger the opening the more efficient the stoma, although it was not invariable that the food would pass through it.

In operating on humans we do not always have a choice unless we excise the ulcer-bearing area and close the pylorus, and we must put our stoma a considerable distance from the pylorus if there is a large ulcer. If the pylorus is eradicated the food must go through the new opening. If only partly closed and we are compelled to put our stoma into the cardiac end of the stomach the food

will continue to go through the pylorus if it is still open. A spasm of the pylorus may close a patent pylorus. Bismuth, when combined with milk or soft solids, has a tendency to dribble through the stoma, but this cannot be characteristic of the solid food.

We would differ therefore from the conclusions of Prof. Hartmann and say that the tendency is invariably to go through the pylorus if the pylorus is open. Never place the stoma on the cardiac portion of the stomach if it can be avoided.

EXTIRPATION OF THE SPLEEN FOR DISEASES OF THE BLOOD

By E. RANZI
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Allow me to speak to you a few words about operations upon the spleen, which lately have caused very much interest. I will confine myself to the extirpation of the spleen for the diseases of the blood.

We have made, at the surgical clinic of Professor von Eiselsberg in Vienna, twenty extirpations of the spleen for diseases of the blood.

With the exception of two cases from Professors Chvostek and Türk, the indication for the operation was made by Professor Eppinger in Professor von Noorden's clinic in Vienna.

The cases are divided into the following groups:

The first group contains three cases of hemolytic icterus. We find in these cases, by the clinical examination, attacking-pains of shorter or longer duration in the region of the gall-bladder, changing of jaundice, general exhaustion, enlargement of the spleen and liver. One of these patients was operated more than a year and a half ago and has increased twenty pounds; a second, who was operated a year ago increased twenty-four pounds; a third operated last year, in July, increased seven pounds. In the above-mentioned cases the jaundice disappeared, the patients feel well and are able to work.

In the second group there were 5 cases of pernicious anemia. These patients have been operated ten, seven, six, three, and one

months ago. Later examination showed in four of these cases a very good result, one died on the fourth day after the operation as the consequences of pneumonia. These patients, who formerly were very weak and obliged to keep to their beds, have quite visibly regained their strength and weight. One of them is better, while the other three are quite able to work. The time of improvement was different in each case. These four patients increased in weight from ten to twenty-eight pounds.

To the third group belong 9 cases, which agree with symptoms of Banti's disease and of hypertrophic cirrhosis of the liver. The oldest of these cases has been operated more than two years ago. Seven of these patients are quite well, some of them regained their strength very considerably. Among them was a doctor, operated by Professor von Eiselsberg, who is now able to resume his very severe practice as country doctor. The following case is remarkable: In the case of a man forty-six years of age, from whom the spleen was extirpated in April, 1913, appeared a carcinoma in the rectum six weeks after the extirpation of the spleen, which was not visible before the splenectomy. It was possible to remove the tumor radically. As the patient had been examined per rectum before the splenectomy, as is quite natural to be understood, the tumor must have rapidly grown after the extirpation of the spleen. This agrees with experiments which Drs. Oser and Porbrain made at our clinic. They found that in rats, from which the spleen had been extirpated, the inoculation of malignant growths took better.

In a fourth group I relate about cases which probably treat of primary thrombosis of the splenic vein with secondary enlargement of the spleen. In clinical view, these cases are characterized by the fact that jaundice never appears but that they come to the clinic under the appearance of an ulcer in the stomach with hematemesis or blood in stool. We can relate details of three such patients. One of these was improved after seven months; a second case has increased twenty pounds and is quite able to work; the third died eighteen days after the operation. The postmortem examination showed pneumonia and thrombosis of the portal vein.

Splenectomies (20 Cases).

		Name.	Sex.	Age	Operation.			Spleen.		State of the blood. Before operation.		State of the blood. After operation.		Later examination.	
					Date.	Operator.	State.	Size. inches.	Weight ounces.	Red-blood part.	Hg.	Red-blood part.	Hg.	After:	
Hemolytic icterus (3 cases).	1	C.	F.	21	June 4, 1912	Clairmont	Moderate adhesions	6¼x4½	35.0	3.0 mm.	38	Normal	Normal	1 yr. 9 mos.	Increased 20 pounds, feels well, no jaundice.
	2	K.	F.	30	April 30, 1913	Ranzi	Expanded adhesions	8½x6½	45.0	1.7 mm.	35	5.0 mm.	100	1 yr.	Increased 24 pounds, feels well, no jaundice.
	3	J.	F.	27	July 9, 1913	Ranzi	Simple adhesions	7½x5	...	2.0 mm.	47	.....	....	9 mos.	Increased 7 pounds, no jaundice, able to work.
Pernicious anemia (5 cases).	4	D.	F.	46	June 4, 1913	Ranzi	No adhesions	5½x4¼	21.3	0.5 mm.	22	2.0 mm.	30–40	10 mos.	Increased 22 pounds, visibly improved.
	5	S.	F.	57	Sept. 9, 1913	Ranzi	Simple adhesions	4½x3	...	1.7 mm.	30	3.5 mm.	75	7 mos.	Increased 11 pounds, able to work.
	6	J.	M.	45	Oct. 15, 1913	Ranzi	Simple adhesions	6 x3½	...	1.6 mm.	41	3.75 mm.	93	6 mos.	Increased 28 pounds, able to work.
	7	H.	F.	51	Jan. 8, 1914	Ranzi	Simple adhesions	4½x3½	...	1.1 mm.	25	2.0 mm.	30 Sahli	3 mos.	Still in the inner clinic.
	8	R.	M.	42	Feb. 26, 1914	Ranzi	No adhesions	...	13.3	1.3 mm.	30	.....	....	....	+4 days after operation, pneumonia
Banti's disease and hypertrophic cirrhosis of the liver. (9 cases).	9	E.	M.	21	Oct. 3, 1906	Clairmont	Expanded adhesions	...	...	5.8 mm.	90	.....	....	....	+6 days after operation. Peritonitis after perforation of ulcer of duodenum.
	10	K.	F.	20	June 24, 1908	Eiselsberg	Expanded adhesions	...	...	4.0 mm.	50	.....	....	....	+ 4 hours after operation, shock.
	11	B.	F.	24	July 1, 1910	Haberer	Simple adhesions	...	...	...	...	.....	....	....	Without report.
	12	S.	F.	27	Apr. 27, 1911	Eiselsberg	Numerous adhesions	7½x4½	...	3.34 mm.	65	4.6 mm.	85	2 yrs. 4 mos.	Increased 8 pounds, no jaundice, able to work.
	13	G.	M.	46	Apr. 11, 1913	Ranzi	Simple adhesions	6½x4¼	26.2	4.6 mm.	90	4.8 mm.	100	1 yr.	Increased 10 pounds. Extirpatis recti for carcinoma. Increased further 8 pounds, no jaundice.
	14	V.	F.	54	Apr. 15, 1913	Ranzi	Simple adhesions	7 x6	49.0	4.2 mm.	78	4.9 mm.	96	1 yr.	Increased 4 pounds, no jaundice.
	15	B.	M.	45	Apr. 21, 1913	Eiselsberg	Simple adhesions	7 x6	35.0	5.0 mm.	100	5.0 mm.	100	11 mos.	Able to work, no jaundice.
	16	N.	F.	53	May 14, 1913	Ranzi	No adhesions	7 x3	38.5	3.9 mm.	65	4.3 mm.	69.7	10 mos.	Increased 7 pounds, improved, no jaundice.
	17	H.	M.	26	June 16, 1913	Ranzi	Simple adhesions, swollen bloodvessels	7½x6	...	5.2 mm.	97	5.2 mm.	91	9 mos.	Increased 20 pounds, able to work.
Thrombophlebetic forms (3 cases).	18	K.	F.	48	June 17, 1913	Ranzi	Expanded adhesions	7 x4¼	32.2	3.2 mm.	35	4.5 mm.	70	9 mos.	Increased 4 pounds, feels well, postoperative thrombosis.
	19	W.	F.	43	July 10, 1913	Ranzi	Numerous adhesions, swollen vessels	8 x5½	29.7	4.1 mm.	70	4.9 mm.	85	8 mos.	Increased 20 pounds, able to work.
	20	J.	F.	46	Sept. 9, 1913	Ranzi	Expanded adhesions swollen vessels	9 x5	...	4.0 mm.	86	.....	....	....	+ 18 days after operation: pneumonia, thrombosis of the portal vein.

Of all our twenty patients, four died after the operation. The first one died four hours after the operation of shock, the second six days afterward from the perforation of an ulcer on the duodenum, which was there before operation. The third and fourth cases of death I have already mentioned; both died of pneumonia.

These numbers show that the dangers of the extirpation of the spleen are considerable. One of the principal causes of the danger is the general low state of health of these patients. Further, I must mention the technical difficulties which are to be found in connection with some cases. They can be caused by two circumstances: (1) by the expansion of the adhesions, particularly on the upper pole; (2) by enlarged and twisted bloodvessels. In one of our cases the adhesions were so excessive that we would cease with the extirpation and would content ourselves by ligature of the splenic artery; in the end we were able to make the extirpation. As a favorable circumstance in the cases of excessive adhesions I must mention that tumors of the spleen are generally of compact consistance, so that in the extirpation a certain tracture can be applied without hemorrhage.

Further, the operations can become more dangerous and made more difficult by the swollen veins. This is particularly the case by the patients of the fourth group.

Lastly, exists in these cases which treat of a primary vessel disease, the danger of the thrombosis of the portal vein. One of the deaths occurred from this cause. I saw the same event happen after the extirpation of the spleen on account of leukemia. The postmortem examination of this patient showed, besides the embolism of the pulmonary artery, an excessive thrombosis of the splenic vein which continued to the portal vein and closed the right principal branch of this vessel in the liver.

In other cases the extirpation was very easy, for instance, in some cases of pernicious anemia.

We have tried to execute the operation under local anesthesia after an injection of scopolamin-morphin. In cases where it was not successful we gave an anesthetic of ether.

In most cases we closed the abdominal wound without a drainage; only in such cases, where on account of expanded adhesions of the upper pole of the spleen with diaphragm, greater bleeding occurred, we used for two days a plugging.

To expose the spleen we make in cases where the spleen is small, a cut parallel to the left rib-bow; in all cases where the spleen is large we open the abdomen by a corner-cut which gives us excellent access to the spleen.

The extirpation of the spleen appears indicated: (1) in hemolytic icterus; (2) in Banti's disease, and (3) as new indication in pernicious anemia. This indication was first shown by Prof. Eppinger in Vienna. The result in the above cases is an exceedingly good one. But if it really results in the complete restoring of the health, that we cannot yet say. In the thrombophlebitic forms the operation appears to be allowed; only then, when severe bleedings of the stomach or intestine have preceded.

To conclude, I will again draw your attention to the good results in many cases which showed a quite unfavorable prognosis till now without operating, and I will recommend to you the extirpation of the spleen in such cases in the highest degree.

DISCUSSION

Dr. J. M. T. Finney, Baltimore.

We have had a most interesting group of cases under observation during the last year at the Johns Hopkins Hospital. I have operated upon three of these cases, two of the pernicious anemia type and one of the Banti type. They have all made excellent recoveries. One case had an interesting anomaly, namely, a double spleen. I removed one spleen about two or three times the normal size and then found another spleen with a separate blood-supply, which I removed and which was found to be half again the normal size. The first patient was quite ill, and had been kept alive for a year by repeated transfusions, three or four times in the year, and after each transfusion would get a new lease of life for two or three months. The blood picture would improve, but would then return to its original condition. For about a year now she has had a perfectly normal blood-picture and, so far as one can tell, is absolutely well. This patient belonged to the pernicious anemia type. The other two patients have been operated on so recently that it is impossible to say what the results will be, but the immediate results have been most satisfactory in all three cases.

INTRAVENOUS ETHER ANESTHESIA

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The intravenous introduction of a narcotic into the organism for obtaining a general narcosis has not only proved a success in animal experiments but also in practical use in the treatment of human beings.

Like everything new in medical science which is unusual and apparently not dangerous, it must be accepted with a certain reserve and will not be given a further trial without great precautions, at least with us in Germany, and this has also been the case with intravenous narcosis. Until now only a relatively small number of surgeons have decided to test thoroughly this new method of general narcosis which has been urged by Witzel and others, and which Burckhardt has employed on human beings with success; neither have a great number of surgeons employed it to a great extent on their patients. It was not even mentioned in the recently published *Chirurgieschen Operationslehre*, by Braun, Bier, and myself.

These circumstances induce me briefly to bring this subject before this highly esteemed scientific assembly of American surgeons and to recommend a trial of an anesthetic method, which with a correct indication and by command of the not difficult technique has in many cases done excellent work, and in my opinion in certain ones it has not been surpassed by any other kind of general narcosis. Although our inhalation method is so excellently developed that the changes in connection with it are, generally speaking, small, it happens that we have to treat patients whose condition is so low and weak that the inhalation

method considerably increases the danger of the operative intervention and the local anesthesia does not always induce complete narcosis. For these the intravenous narcosis is a great gain.

The reason that the intravenous narcosis has only slowly gained an entrance into surgery, may lie in the fact that thrombus was feared at the point of infusion with an ensuing dangerous pulmonary embolism.

Information from Kuettner, who among 23 cases observed a pulmonary embolism with dangerous appearances of cyanosis, as well as animal experiments by Clairmont and Denk, from the v. Wiselberg clinic, which made the intravenous narcosis appear uncertain and dangerous, will have increased the theoretically accepted fears of the dangers with which this kind of narcotic is connected.

The experience which we have had until now with the intravenous ether anesthesia is so wonderfully good that it appears to me desirable to introduce its general employment. Up to the present we have used the ether anesthesia in about 250 cases, certainly a small number in comparison with the several thousands of general narcoses which we have used in the course of a year.

The cases we selected for trial only with the greatest care and with choice of every case, proved exactly the influence of a mixed ether and salt solution on the general condition of the patient's kidneys, heart, lungs, and vessel walls. We knew from the very beginning that this method would never take the place of the scopolamin-morphin, ether, or chloroform narcosis, which we administer with the Roth-Daeger apparatus. We have, however, in the course of our observations become convinced that for different groups of cases the intravenous narcosis by the special mode of introducing the anesthetic, and by the reviving effect on the organism, produces an excellent result, and cannot be replaced by any other method.

It seems to me, first of all, that the intravenous narcosis is very suitable for operations on the face and head in general, especially in the mouth and pharynx, upper jaw, at the base of the

skull (hypophysistumoren), etc., as well as operations on the neck. In these operations the narcotizer hinders the operator. The necessity of constantly taking off and putting on of the mask is an obstacle which is absolutely prevented in the case of intravenous narcosis.

There are great advantages attached to a uniform quiet narcotic, that can be administered far from the operating field which permits us to undertake unhindered operations on the face, mouth, etc., and at the same time through the administration of a solution of salt to improve the strength of the patient often reduced through great loss of blood caused by the surgical operations. In 30 cases of tumor on the upper jaw, larynx, thyroid glands, base or roof of the skull, in operations for abdominal tumors, cancer of the tongue and the tonsils, as well as plastics of the nose and similar cases, the method has turned out surprisingly well through the peculiarity of its regular calm which does not disturb and hinder the operating field and the operator and his assistants.

Further, there were weak patients exhausted and reduced in the highest degree mostly through the length of their fundamental disease, with whom the intravenous ether narcosis turned out excellently. These are patients to whom we are in many cases accustomed to apply a common salt infusion at the beginning of the narcosis in order to somehow raise the strength and after all to make still possible the general narcosis.

In the case of such frail patients one is compelled to add an analepticum to the common salt solution flowing into and through the veins which not only raises the effect of the infusion but at the same time puts the patient into a state of harmless narcosis without any further measures being necessary. This is an anesthetizing method which I should like to style, so to speak, as an ideal narcosis. Such patients generally leave the operating room with a much stronger pulse, often with better heart action, and looking remarkably well, much better than before they were placed on the operating table.

In such case they recover from the narcosis quickly and without

uneasiness. We never observed nausea and vomiting after the intravenous narcosis, an advantage which cannot be too highly estimated, especially in the case of feeble patients after interfering. The small quantity of ether which in this form is introduced into the organism is accountable for the relatively good health after the narcosis.

In the following about 100 cases intravenous narcosis has been employed: Cancer of the esophagus and heart, malignant tumors of the stomach, in benign stenoses of the pylorus, in twelve rectum and cecal tumors, in several total extirpations of carcinomatous uteri, in ectopic gestation, in malignant tumors of the abdominal cavity, in diseases of the kidneys, diffuse peritonitis, in patients with fungus in the knee-joint and such as have upper thigh tumors, and numerous other cases.

Concerning the principal questions respecting danger connected with the method, I am under the impression that, starting from the theoretical considerations, they have been considerably exaggerated. One supposed that not only a local formation of thrombus could take place or was unavoidable, or the obvious danger of embolism was taken for granted. These considerations are, of course, quite justified, and have induced us to approach this new method with the greatest caution. Thrombus formation would be the weakest point of the method if one had to fear that this was often the cause of embolism.

What are now the real facts according to the experience we have so far gained concerning the formation of thrombi and consecutive embolism? Neither we nor Burckhardt have, up to the present, experienced any pulmonary embolism with patients to whom intravenous narcosis has been administered. On the other hand at the commencement we often experienced the formation of pulmonary embolism in the vein at the place where it was punctured. On those occasions, soon after the operation, the patient complained of pain over the site of the puncture of the left arm, which lasted a few days. The thickened vein was distinctly palpable for a distance of from about 3 to 5 cm., but developed no further appearances.

In nearly all cases our patients were in advanced stage of of disease, many of them suffering from advanced cancers, causing death in the course of the disease sooner or later after the operation. In several cases we were enabled to control our clinical observations at the postmortem table. In the first autopsy which came under our hands we found a thrombus at the site of the infusion. In those patients we narcotized with this technique, we could let a solution of ether-saline flow into the veins, and at times interrupting the current, fairly thick, firm thrombi appeared, partly occluding the collateral vessels. In the following cases the thrombi were far shorter and softer, and not stronger than those that we, by way of exception, had noticed after ordinary saline infusion, but frequently after the addition of digalen or adrenalin.

In the later group of intravenous anesthesia in which we tried this last improvement of controlling the infusion of the continual flowing and at times changing it with an infusion containing an ether mixture, we could control several times through the postmortem, its effect on the thrombi formation and were able to observe no appearance of thrombus whatever. The danger incident to the thrombus formation at the infusion site appears to me possibly overestimated. Since we have devoted considerable attention to the effect of the ordinary salt solution, especially when mixed with adrenalin and digalen, we have nearly always established the presence of thrombosis after the employment of a medicated infusion, but never a consecutive pulmonary embolism. Generally speaking the occurrence of embolism ensuing from a thrombus in the upper extremity appears to be a rare incident. Certainly our present therapeutics which favors the intravenous introduction of the medicaments would have experienced a severe shock, supposing there was an appreciable danger of embolism. If we had to fear these minor thromboses in the veins of the upper arm, we should have to altogether desist from the infusion of saline solution containing digalen or adrenalin, which is frequently and naturally considered as harmless. No one would envisage the possibility of removing these power-

ful remedies from our therapeutics, also no one has any reason to rob us of this most valuable aid and abandon it altogether, especially as there is no cause for doing so, by unfavorable results. The same applies to the dangers connected with the use of saline solution with ether, even if it represents a substance, which is, to a certain extent, dangerous to the vessel walls, such as digalen or adrenalin, etc. The fact that, through the further improvement in the technique of the intravenous narcosis, we have succeeded in minimizing, or in completely eliminating the thrombosis, will further free this new method of narcosis from the dangers connected with it. As for the value of saline infusion itself, we are ardent adherents of this therapeutic procedure, and believe it has saved many lives. We use it frequently in a great number of cases, and when necessary have injected as much as 18 liters within twenty-four hours, not only without injuring the patient, but, as we believe, with the result of saving life in many instances. It is our practice, whenever edema appears below the lower eyelids and in the sclera, to interrupt the administration of saline solution temporarily, and we follow the same rule in intravenous anesthesia. While we can inject relatively large quantities of fluid into an individual whose feeble desiccated tissues are greedy, a limit is set much sooner with a stronger patient who has a well-filled vascular system. As to indication for the intravenous method, as has been repeatedly stated, it is used in cases of cachectic, emaciated, feeble, and reduced individuals (cancer, ulcers, ventriculi, loss of blood by by extra-uterine pregnancy, injuries, and the like), also with patients who have been exhausted by acute disease such as peritonitis. Further, it will be used extensively in all operations on the neck and head (throat, tongue, and its different parts, etc.), and I believe will find such an extensive employment as has never yet been reached by any other method of anesthesia. In vigorous individuals the inhalation method is preferable, or, if the above mentioned technical indications, namely, head and neck operations make it desirable, one will with all possible care let a saline solution containing ether flow into the veins, and at

the same time combine it with isopral. The intravenous narcoses is contra-indicated in arteriosclerosis, as it is mostly accompanied by a high blood-pressure, serious myocarditis, and general plethora.

After the infusion of the narcotic, we have never noticed any complication ensuing from either the heart or the lungs, with the exception of one case, where an already additional existing lung and larynx tuberculosis made it apparently worse. In a case of amyloid of the kidney, the quantity of albumin excreted in the urine the first few days following operation was slightly increased, in the remaining cases, the urine was free from albumin, blood, or renal constituents.

In a great number of cases a venesection was done on the patient immediately after the operation, the blood being drawn from the basilic vein on the opposite side; neither microscopic nor spectroscopic changes in the blood-cells or their tingibility or in the hemoglobin content were found. This may be due to the fact that the 5 per cent. ether mixture does not develop its full effect, because only 4 per cent. of ether is soluble in water to begin with, and because part of it escapes from the open vessel used in the infusion, or, if the vessel is covered, collects above the level of the fluid. This can be demonstrated by holding a burning match over the vessel, when the ether will at once begin to burn with a bluish flame. Probably the solution which enters the vein does not contain more than 3.5 per cent. of ether. Furthermore, it is probable that most of the injected ether is directly excreted by the lungs, as is indicated by the odor of the breath immediately after the anesthesia is begun. Also in later observation of the patients during convalescence, a condition was never found which could be attributed to the disadvantage of this method. For the patients themselves the narcosis is very agreeable. Headache, vomiting, or other consequences have not been observed. It happened several times that the patients themselves wished to be "narcotized through the arm," having heard from their neighbors in the hospital, the agreeable effect of this method. Seven times, at a further necessary operation,

the intravenous narcosis was administered for the second time to the same patients at their own wish.

Concerning the actual administration of the intravenous anesthesia, experience and exercise, just as in lumbar anesthesia, play a very important part. Before the operation all patients from the twentieth to sixty-third year received our usual dose of three to five 10,000 gr. scopolamin and 1 ctgr. morphin indifferently whether inhalation or an ether anesthetizing method is employed. While in partial anesthesia the patient is placed on the operating table, the eyes are covered, and with the usual antiseptic precautions the vena mediana cubiti is exposed and the tube is introduced just as if the saline infusion should be administered. To avoid clotting as much as possible we endeavor to maintain a continuous stream by fixing two glass vessels on a stationary easel, one of which is filled with a 4 per cent. ether saline solution and the other one with a 41 per cent. physiologic saline solution. Both rubber tubes from these vessels are joined and attached to a Y-shaped piece of glass tubing which has on its lowest branch a stop-cock, which can easily be regulated, and a rubber tube to which is fixed a cannula. This stop-cock makes it possible to inject very small quantities of fluid with absolute uniformity. For instance, after a sufficient quantity of the ether mixture has been given to produce a satisfactory anesthesia, the ether mixture is shut off with a clamp, and physiologic salt solution is slowly injected until the reappearance of reflexes again calls for the use of the ether mixture. The tube supplying the saline solution is then closed and that connected with the ether mixture turned on. This arrangement permits a constant anesthetization with accurate dosage as the vessels are graduated and the quantity of fluid can be accurately read off at any moment.

By the use of a suitable serviceably pierced stop-cock the regulation may be obtained in a still more comfortable and simple manner. The illustration will show the apparatus in the clearest manner.

Tolerance comes mostly after ten minutes in the case of weak

patients, even after four or five minutes with a required quantity of liquid of 100 to 300 gr. = 4 to 15 gr. ether so that the operation can begin at once, in some cases even after one and one-half to two minutes. Except for slight avertive movements we seldom saw excitation. Only in a case of a twenty-four-year-old, often-anesthetized young man the gravity of the state of excitation made the continuation of the infusion narcosis impossible. In three further cases, which concerned especially excited individuals "potatoren," as an exception a small quantity of chloroform was given and then the infusion was continued to the end.

At the beginning of our experiments, before we employed the continuous infusion we experienced, twice, a light cyanosis, and once, asphyxia which necessitated artificial respiration; probably, through want of sufficient experience, too much ether was injected within a second, and so this interruption was occasioned. The cyanosis stopped immediately upon discontinuance of the ether mixture. In opposition to the opinion of Dumonts I should especially like to mention that at the appearance of the slightest dangerous symptoms the application of the narcotic can be interrupted not less quickly and perhaps quicker than with the inhalation narcosis. Almost without exception the narcosis passes off remarkably quietly; respiration uniformly good; pulse, through the introduction of water, stronger; with the exception of the unimportant interruptions previously mentioned we have experienced no bad accidents.

The longest duration of an intravenous narcosis was necessary in the case of a feeble, starved individual with a cardiac cancer necessitating an extensive resection of the stomach, the removal of the cardia and 10 cm. of the esophagus. Within one hundred and forty minutes 1700 cm. ether mixture = 85 gr. ether was injected. I believe that the good progress of this intervening operation and the healing after resection of the cancered cardia are principally owing to the restorative effects of the intravenous narcosis. With another patient in whom a tumor at the base of the skull was removed by a temporary

resection of the upper jaw, we used in one hundred and five minutes only 900 c.cm. ether mixture = 45 gr. ether; further in an operation for ruptured aneurysm of the belly arteries and seams, in about one and a half hours about 60 gr. ether were used. In one narcosis 3700 gr. fluid was injected and the patient recovered.

In order to accelerate the beginning of the narcosis, particularly with potatoren and strong patients, we have combined the intravenous ether narcosis with another narcosis.

From the sleep-producing substances veronal, hedonal, and isopral, we have preferred the latter, which was first employed and recommended by Burckhardt as it seemed to contain the least dangerous additional effects. The intravenous hedonal narcosis which is principally employed by Russian surgeons (Fédoroff, etc.) appears to me to be not without danger for the breath centre, heart, and lungs, as is also shown by the experiences of Beresnegowsky; also with the pure isopral method the same author has observed dangerous effects on the heart, liver, and kidneys.

I would not recommend a pure intravenous isopral narcosis, as it seems that by a longer and exhaustive use the blood-pressure was essentially reduced and a bad effect caused on the breath centres. With us, however, the employment of an isopral solution of 1 to 1.5 per cent. has turned out very well for the introduction and shortening of the intravenous ether narcosis and when employed correctly and prudently there have been no disadvantages.

Since October, 1912, we employ this combined process exclusively and have tried it in about 80 cases. The technique remains the same. A third cylinder is fixed to the easel according to Burckhard's instructions, which is filled with the sterilized solution of 1 to 1.5 per cent. according to Ringer. For dissolving the the solution, about 24 hours are required, as only a temperature of 30° heat is allowed. It is important that the solution of isopral should flow in slowly, *i.e.*, in about five minutes no more than 100 gr. If isopral flows in either too quickly or if too large

a quantity is used asphyxia or cyanosis may take place, which however disappears at once after the current has been interrupted. Only in one case, viz., a feeble patient suffering from an inoperable cancer of the stomach with caruncle in the peritoneum, we noticed a stopping of the breath while the pulse was beating strongly and fully, nevertheless it was necessary to practice artificial breathing for a short time. This had occurred through letting the solution of isopral flow in too quickly. In most cases 80 gr. of solution of isopral is sufficient to produce within three to five minutes the tolerance stage; it is not advisable to use more than 150 gr. solution equal to 1.5 to 2.25 isopral. After the narcosis has taken place same is continued simply by turning the stop-cock and by continuing with the solution of ether-saline. In the case of feeble persons ether narcosis alone is sufficient.

In our opinion and according to our experience the intravenous ether narcosis is a form of anesthesia for human beings which up to the present, by a proper indication for a certain group of illnesses has not been surpassed by any other form of general narcosis. I should like to indicate same for many cases as being an absolutely ideal narcotic, as it is, besides the small quantity of narcotic which is used, a reviving and analeptic narcosis, which we cannot say about any of our other well-known narcotics.

The 1 to 1.5 per cent. solution of isopral is of excellent assistance for the introduction of the intravenous ether narcosis, as through the same a quicker tolerance stage is obtained, especially in the case of potators or patients who are not easily narcotized. Too quickly flowing in of the solution or too large a dose can cause, as we have learned from measuring the blood-pressure, both sinking of the blood-pressure as well as cyanosis. We have not yet experienced any disadvantages in the case of intravenous isopral-ether narcosis.

DISCUSSION

Dr. E. Wyllys Andrews, Chicago.

Following a demonstration of this method which I saw by Professor Kümmell, in Hamburg, we have tried it in our clinic in about sixty cases. It has, in our opinion, a very decided advantage, but also very decided limitations, as Professor Kümmell has stated. The technique employed by Bier has been precisely that which we have used, and those who saw it demonstrated in my clinic at the congress in Chicago last November will remember that in those cases which we showed it worked to perfection. The solution in the ether reservoir should be from 5 to 10 per cent. In our experience 5 per cent. is too weak for some cases, and yet 10 per cent. comes dangerously near the point of laking blood or producing embolism. The beauty of the method is that it is admirably adapted to throat and face cases, that it is quick in its action, and in our cases at least it was seldom followed by nausea or vomiting. The time of induction was usually from three to six minutes; the duration of anesthesia after the turning off of the flow from the ether was uniformly five minutes, at which time a slight tendency of the patient to wake would cause the assistant to turn the stream of 10 c.c. in again, thus giving five minutes more.

Our series included one death, which probably was due to the anesthesia. Like one reported by Bier, it may have been due to embolism.

With regard to this case, which was that of one of my colleagues in which I was working with him, we were led to believe that the danger Bier warns against of possible embolism is a constant one. Nevertheless, with a method so sure and quick and non-irritating to lungs or air passages (no coughing, mucus, or vomiting) it is probably true that with an accurate dose and simple technique this method may prove of extreme value in selected cases.

OUR EXPERIENCES UP TO DATE IN THE TREATMENT OF MALIGNANT TUMORS BY RADIUM

By RICHARD SPARMANN, M.D.
VIENNA

My chief, Professor Freiherr von Eiselsberg, of Vienna, asked me to tell you briefly about our experiences up to date in the treatment of malignant tumors by radium.

Since July, 1913, we have handled 52 cases of inoperable malignant growths (carcinomas and sarcomas). I emphasize particularly the fact that all our cases were inoperable because from the very beginning we were convinced that we should not treat with radium any operable tumors. Moreover, we have used radiation following an operation on tumors which were not radically removed. In every case the clinical diagnosis of malignant tumor was confirmed by a histological examination.

Before I go into any detail about these cases and the conclusions we came to, I would like to say a few words about our method of the application of radium. We had 225 mg. radium and 150 mg. mesothorium at our disposal. This quantity was divided into fifteen applicators. These were applied partially externally and partially internally; in the latter case in the periphery of the tumor. We often reduced the tumor as much as possible before the irradiation. We also made use of cross fire. The filters were made of silver, gold, platinum, magnalium, and brass, or of rubber in various thicknesses from 0.5 to 2 mg.

At first we gave big doses up to 11,000 mg. hours at a time. In the last five months, however, we used at the most 1200 to 2000 mg. for several hours for one dose. We made this change because we found that it had often a great influence on the

general condition of the patient, or that the radium destroyed the healthy tissues far beyond the limits of the tumor in too short a time. In every case the patients were given arsenic in the form of Fowler's solution to improve their general condition.

We divided our cases into two series, the first of which received preventive and the second curative treatment. Of 6 treated in the first way, only 1 has remained free from recurrence. Among all the cases treated curatively as well as preventively only 11 have remained free from tumors up to this time. Of these 7 treated curatively were five cases of epithelioma cutis. One was a case of carcinoma linguæ, 1 a case of metastasis in the lymph glands after sarcoma axillæ. Of the 4 treated preventively, 3 cases were carcinoma mucosæ oris, 1 sarcoma orbitæ. In 6 cases we noted improvement; 14 were aggravated; and in 5 no effect could be seen during the period of treatment; 17 died. Of these 17 cases 11 died as the result of the tumor. One died from hemorrhage, 2 from meningitis, 1 from old age, 1 from diabetes, and 1 from mediastinitis.

Formerly we had the hope that it might be possible to prevent, or at least retard, recurrence by preventive irradiation. Now, however, we have come to the conclusion that on the contrary the recurrence was sometimes hastened by postoperative irradiation, possibly due to a local hyperemia caused by radium.

From the above-mentioned results we see that radium is not a panacea for malignant tumors. Not only does it not always help, but it often injures patients as well in regard to the local lesions as by its harmful effect upon the general condition, manifested by tachycardia with a pulse rate up to 120 and 140, dizziness, weakness, and vomiting. The latter has been observed especially by irradiation of the neck, probably due to irritation of the vagus. The local ill-effect is especially marked in that the healthy tissues are badly injured so that we cannot prevent their further destruction. There is furthermore a great danger of causing a hemorrhage or perforating a hollow organ, such as the intestines. We had 11 hemorrhages among our cases, 1 of them lethal. Another case died of mediastinitis.

There is no such thing as elective effect. The tumor cell is not more easily destroyed because of the specific action of the radium itself, but being a degenerated cell, it is more susceptible to the effect of any trauma. We have seen only a greater susceptibility of the epithelium in contrast to the fibrous tissue.

As far as histological changes are concerned, I can only make the statement that there is no specific change in the tissues to be seen by radium irradiation. All we see is necrosis and subsequent scar-formation, such as could be formed spontaneously in any tumor tissue.

Radium has only a local effect; therefore, it can never take the place of an operation by which we can reach as far as possible all parts of tumor dissemination as by the Wertheim operation for cancer of the uterus, or by the operation for cancer of the breast with removal of the lymphatic glands. We have noticed in certain cases that during the treatment metastatic foci have been formed in lymphatic glands.

The indication for treatment by radium in the case of a growth which has attacked a vital organ must be the same as for an operation.

The hopes we placed in radium as a new and successful means in the treatment of malignant tumors have not been realized. Moreover, the number of cases in which one might have recourse to radium therapeutics shrinks constantly as our experience progresses.

DISCUSSION

Dr. Robert Abbe, New York.

Although the statements we have heard may appear rather startling, yet I am sure we can accept them as absolutely correct. I think it is borne out by our own experience that carcinomatous tumors in the sense of the malignant carcinomatous nests of cells are destroyed by radium, not by a specific action, but through a necrotic action or through a secondary anemia from obliterating endarteritis of the vessels supplying the parts. Insofar as this takes place it is of tremendous advantage in dealing with many of these diseases because you do produce an atrophy of the tissue if you give a judicious dose of radium. If you give too much of a dose, as I have formerly said, and as von Eiselsberg has demonstrated, you produce a toxemia from absorption of the necrotic tissue. Sometimes it makes a sickness like la grippe which passes off. Sometimes, if you make too severe an attack of the disease, you will produce sickness for about a week. But that does not deal with the question of the value of radium as a specific in malignant disease. You must consider not only carcinomatous nests of cells which you can reach, but sarcoma and other life-destroying tumors, and upon these radium has a specific action. I say a "specific action" with a guarded feeling about the use of the word. Take, for instance, a myeloid sarcoma, a tissue-destroying tumor, a life-destroying tumor, springing from the true myeloid tissue of the bones, losing the contour of the bones by absorption of the calcareous matter, with great destruction of the bone; that type of myeloid tissue will be driven back to a normal line of cell growth and reproduction by the simple application of radium. A jawbone destroyed entirely by a neoplasm of myeloid structure will be reformed as bone presenting the same structure as the original bone. I have one such case now well after ten years; you cannot see the difference in the two sides except that one is a little thicker. This result has been repeated in ten or twelve cases of myeloid tumors. If that is not specific action there is no such thing as specific action. It is a true driving back to a normal line of cell growth and living tissues in cases of malignant growth. Not alone the myeloid sarcomas but also the round-cell sarcomas are affected favorably. We have not yet been able to control all these, but some cases are amazing and others very encouraging. I have today, in St. Luke's Hospital, a man who a year ago had a destructive round-cell sarcoma, making a huge tumor on the skull, resting on the dura, and destroying

the skull. I inserted radium tubes into the tumor after having removed a specimen for examination. The entire tumor has now been cured for four months. Yesterday I could find only a thin fibrous layer remaining. There was absolutely nothing done in this case except the insertion of radium. Here, again, is an example of its specific action.

This subject is too large to deal with it exhaustively, but I will illustrate what I mean by specific action. Take warts and basal-cell epitheliomas, all cured by radium, retarding and leaving normal structures (except where the original disease has destroyed tissue). Warts can be destroyed by caustics, etc. In that case you remove it. But if you put radium on them, the papillomatous cells recede leaving no trace or scar behind. That is a specific action on the cells. The neighboring cells are not affected. Papilloma of vocal cords affected by radium disappear and leave normal vocal cords, the mucosa of the cords white, with perfect function if you give just the right amount of radium.

Therefore, judging from my experience, which has extended over eleven years, in which time I have treated over a thousand cases with radium, I believe that radium has a specific action upon certain types of malignant disease.

Dr. K. A. J. Mackenzie, Portland, Oregon.

I would like to say a few words regarding the value of a simple radium apparatus which I have. While in Paris three years ago, I met a cousin of mine who was under the care of Drs. Wickham and Degrais, because of a rodent ulcer affecting the tissues at the angle of the ear, and followed him through his course of treatment, observing the results from day to day, and also witnessed many types of disease being treated in the institute.

I was so much impressed with the results that I saw in advanced cases that I ventured to buy a small apparatus in which the radium was held in a varnish or paste. It has a radioactivity of 500,000, which means that uranium being the unit, it possesses 500,000 times the radioactivity of uranium.

I have used it in about twenty cases, chiefly in superficial epithelial cancers, rodent ulcers, and also in cases of keloid and rapidly growing anginomata in children. I have also used it on a case of deep-seated cancer of the jaw. I wondered at the results; in all these selected cases they have been remarkable.

One patient had epithelioma in the bridge of the nose extending to the bone. I utilized the apparatus and gave her one hundred hours'

exposure, and she left for her home in Washington without visible signs of improvement of the condition; but a few months later she returned and the cancer had absolutely disappeared without leaving any scar behind.

The same holds true in other disorders. It has always had a striking effect in deep-seated disease in relief of pain.

It should be remembered that I am speaking only of the results obtained from the use of a single apparatus which is relatively weak.

Dr. James E. Moore, Minneapolis.

I wish to relate very briefly an experience I had in the treatment with radium of an adenocarcinoma. A patient from South Dakota, suffering from a well-established malignant growth of the breast, refused operation and came to New York. An incision was made into the tumor direct, a radium tube applied, after the *x*-ray had proved ineffectual. She remained so long under treatment that she became discouraged and returned to Dakota and was referred to me by her home physician for operation. I did the radical operation on the breast, which had a large crater in it, foul smelling, and gangrenous. A few months later I had a letter from the physician in New York, asking for a report on the tumor after its removal. I have to report to him that most careful examination showed that beyond the immediate area where the sloughing had taken place there had been no change whatever in the growth. It was an adenocarcinoma remaining just as if the radium had not been used. The patient is living and well today.

Dr. Sparmann (by invitation, in closing).

We have also seen in one or the other case a very surprising effect by irradiation. It is not allowable, however, as we feel, to draw any conclusions at all from single cases, and it is always necessary to consider the entire material. We have only seen definite results in superficial processes, as in epithelioma cutis, etc. If we were sometimes able to destroy a deep tumor, a local ill-effect, as well as a very bad influence on the general condition, has been observed in some of the cases, and the final therapeutic results are very questionable indeed.

RESULTS OF CONSERVATIVE TREATMENT OF CYSTIC DISEASE OF THE BREAST

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BOSTON

AND

CHANNING C. SIMMONS, M.D.
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The pathological condition which is commonly known in English medical literature as "cystic disease of the breast," and in German publications as "chronic cystic mastitis" (Koenig: mastitis chronica cystica) has had many other names applied to it, and many attempts have been made to determine its significance as a precursor of carcinoma. It is a generally accepted fact that a certain percentage of cases of this disease sooner or later show evidence of carcinoma. The percentage of cases in which carcinoma occurs has been estimated by the majority of writers as in the vicinity of 10 (Greenough and Hartwell, Tietze, Warren). These figures, however, have been based upon series of cases of cystic disease in which operation has disclosed the presence of carcinoma. Thus Greenough and Hartwell,[1] in 1903, published 30 cases, in 3 of which carcinoma was present (10 per cent.); Warren,[2] 115 cases of cystic disease of which 15 were carcinoma (13 per cent.); Tietze[3] estimates 10 per cent. The most recent tabulation is that of Bertel's[4] 21 cases of which 6 were carcinoma (25 per cent.).

The cases here presented give an opportunity for the estimate of the occurrence of carcinoma in this disease from a somewhat different standpoint. Eighty-three cases have been investigated in which cystic disease was present, and proved by pathological examination of the tissue removed at operation, but all were

cases in which only a partial removal of the diseased gland tissue was performed. The subsequent incidence of carcinoma in these cases, therefore, gives a further light upon the tendency toward its development in cystic disease of the breast.

For the purposes of this paper disease of the breast[5] may be defined as a diffuse process involving a large part, if not the whole, of one breast or of both breasts, and presenting an increase of the interlobular connective tissue and dilatation of the gland ducts into macroscopic or microscopic cysts. Within these cysts the gland epithelium shows a variety of different conditions, of which we distinguish three main classes: (1) the simple fibrocystic type of the disease with flattened or atrophic epithelium, and two types showing epithelial proliferation; (2) papillary epithelial proliferation; and (3) adenomatous epithelial proliferation. It is our belief that the latter class (3) is very near to the line of infiltrating epithelial growth or carcinoma.

We do not include as cases of cystic disease, cases of the type known variously as "papillary cystadenoma," "villus papilloma," or "duct cancer," in which gross intracystic papillary growths occur, accompanied often by the discharge of blood from the nipple. This condition we have regarded as true local tumor formation, and one which has its own, and indeed a very high, predisposition to carcinoma.[6]

McCarthy,[7] of the Mayo clinic, has recently described three groups of epithelial growth in cystic disease: (1) frankly benign; (2) doubtful, suggesting the possibility of carcinoma, but without infiltration; and (3) carcinoma. For clinical purposes this classification is simple and comprehensive, but it is our belief that the line between Class 1 and Class 2 will be hard to draw, and that the designation of any lesion as carcinoma, without evidence of infiltration of the stroma with epithelial cells, is a difficult feat for the most expert pathologist to attempt.

The varied character of cystic disease is well shown by the number of different names that have been applied to it. It is certainly true, as recently emphasized by Syms,[8] that a very

careful gross serial section of the breast, with microscopic examination of the more suspicious areas, is necessary for an accurate pathological report upon the tissues removed at operation. Indeed, we have been struck with the fact that changes of the epithelium, quite analogous to those found in cystic disease, occur in other diseases and tumors of the breast—as for instance in periductal fibroma and sarcoma, and in some of the chronic inflammatory conditions following incomplete lactation. From these facts we would conclude that the proliferative epithelial changes which occur in cystic disease are not peculiar to this disease of the breast alone, but are phenomena associated primarily with the epithelium of the tubules and acini of the mammary gland. Under such abnormal conditions as occur in cystic disease, and in some local tumor growths, the breast epithelium reacts to the stimulus of altered conditions and undergoes proliferative change of various degrees of abnormality, the highest of which is the unbalanced and invasive growth to which we give the name of carcinoma.

The material upon which this report is based is derived from the Massachusetts General Hospital, and from the private practice of some of the members of its surgical staff.[1] The largest number of cases from any single operator come from the records of Dr. J. Collins Warren. To these gentlemen, as well as to Dr. W. F. Whitney, Dr. J. H. Wright, and Dr. H. F. Hartwell, of the pathological department of the Massachusetts General Hospital, we here express our thanks for the use of their material and for much valued assistance and suggestion.

For the purposes of this paper a gross and microscopical pathological examination of the tissue removed was considered essential in every case. We were able to collect 102 cases of cystic disease, treated primarily by something less radical than

[1] Drs. J. C. Warren; W. M. Conant; E. A. Codman; Hugh Cabot; J. G. Mumford; John Homans; C. B. Porter; M. H. Richardson; F. B. Harrington; A. T. Cabot; S. J. Mixter; H. H. A. Beach; J. W. Elliot; D. F. Jones; C. A. Porter; H. Williams; F. G. Balch; C. L. Scudder; C. C. Simmons; and R. B. Greenough.

amputation, which fulfilled these conditions, and in 83 of these cases we ascertained the later results. Many other cases of this disease in the same period were treated by amputation, but they are not included in this report, as they do not provide the desired data in respect to the subsequent occurrence of carcinoma in cystic breasts.

In 1897, Dr. J. Collins Warren began performing the operation which he later described and published as plastic resection of the breast.[9] The operation was based upon the theory that operative removal of the diseased portions of the breast tissue was to be desired, but that the mutilation of an amputation was to be avoided if possible, in order that patients might not hesitate to accept the advantages of early operation on account of the sentimental aesthetic objections to the more dreaded amputation.

Dr. Warren employed the familiar Thomas incision beneath and outside the breast, carrying it well into the axilla to gain access to the large and more frequently affected upper outer quadrant. He then raised the gland from the pectoralis major, removed the diseased quadrant, and in more advanced cases the greater portion if not the whole of the gland tissue, and replaced the skin and fat of the breast, leaving the nipple in place. In some cases a reconstruction of what was left of the gland tissue and fat was made with buried sutures. The operation has been performed at the Massachusetts General Hospital and elsewhere in many cases of cystic disease. It has not been applied to all cases for a number of reasons. The very mildest cases of this disease, those in which the diagnosis was open to question, and those in younger women, have not been considered suitable cases for any operation. In severe cases—those in which the disease is widely spread in one or in both breasts, those in which a previous operation or exploration discloses a high degree of epithelial proliferation, and those in which errors of diagnosis have occurred or where the supposed probability of the presence of cancer has dictated a wider excision as the safest procedure—in all such cases amputation has been done. Of 33 operations

for cystic disease, performed by the writers in the past two and a half years, 19 were amputations and 14 were partial resections.

Of the 83 cases of cystic disease, which forms the basis of this report, in 14 both breasts were operated upon—a total of 97 operations.

In 59 cases partial plastic resection was performed, and in 32 a local excision was made of the affected portion of the breast. In two cases all of the gland tissue was subsequently removed by the plastic operation (subcutaneous amputation), and in four cases a later total amputation was done.

The subsequent histories of the 83 cases have been investigated, and they are of considerable interest. The length of time elapsed from the first operation varies in these cases from one to seventeen years, an average of over seven years for each case. The results, however, must not be regarded in any sense as *end* results, for there is no limit of age at which the possibility of the occurrence of cancer can be excluded. We offer the results of this investigation only as evidence of the natural history of cystic disease of the breast, which must be taken seriously into account in determining its safe and proper surgical treatment.

Four of the 83 cases, or 4.8 per cent., developed carcinoma of the breast—3 after partial plastic resection, and 1 after a simple excision of the tumor.

These cases are worthy of more detailed report:

Case XV.—Thirty-three years, single, had an excision of a cyst of the size of a half lemon, of one year duration. Pathological examination shows one main cavity, and two smaller cavities, lined with a smooth membrane, 1 mm. thick, and containing yellow fluid. There had been discharge of this fluid from the nipple. Three years later the patient presented herself in the Out-patient Department with a large ulcerated tumor of the breast, adherent to the chest wall, and with large glandular metastases in the axilla—inoperable carcinoma.

Case XXXI.—Came to the hospital in 1898, at sixteen years of age, with a cystic hygroma of the left neck and axilla, extend-

ing down to the border of the left breast. This was removed. In June, 1904, she presented herself again at the hospital with indurated fibrocystic areas in the left breast and to a less extent in the right also. At the time she was twenty-two years old. Partial plastic resection of the left breast was done. Very little epithelial proliferation was found, but a large amount of fibrous tissue. One year later she came again to the hospital with a large mass occupying the upper half of the left thorax, the axilla, and beneath the clavicle. A specimen of tissue removed for diagnosis showed undoubted adenocarcinoma. No further record of this case is obtainable.

Case XXXVIII.—Female, aged forty-two years, came in for diffuse induration of the left breast, of six months' duration. Plastic resection was done, and the specimen showed marked epithelial proliferation of the papillary and adenomatous types. Six months later discharge from the nipple began again, and four years later another nodule of disease was present in the same breast, but operation was refused. Eight years after the original operation the patient was living, but had carcinoma of both breasts, and both axillæ, with metastases above the clavicle, in the sternum and pleura, and in the spine.

Case LVI.—Female, aged forty-one years, presented a small cystic area of three months' duration. Partial plastic resection was done, and the specimen showed marked epithelial proliferation of the papillary and adenomatous types. The pathologist regarded it as "on the border line of carcinoma." Three years later the patient showed a nodule on the border of the axilla (an outlying lobule of the upper outer quadrant) which was excised and examined, and found to be adenocarcinoma. A complete operation for carcinoma was then done, but no other evidence of carcinoma was found, either in the breast or the axillary glands. Two years later (January, 1914) the patient showed no evidence of recurrence.

Cases XXXVIII and LVI may be considered the typical history of cystic disease of the advanced proliferative type. Case LVI developed adenocarcinoma after three years; XXXVIII

had a return of the cystic disease in four years, and refused operation. After another period of four years she presented evidence of bilateral inoperable cancer. The other cases are less typical—XV developed carcinoma three years after the removal of a cystic area; the degree of epithelial activity in this specimen could not be determined. Case XXXI, that of the cystic hygroma, was an unique case. No evidence of proliferative epithelium was present in the cystic area removed at operation. One year later, however, she presented an inoperable carcinoma.

Of the 83 cases in this series four patients have died of other causes, without evidence of any disease of the breast:

Case XVII, six years after operation, of sarcoma of face and mouth.

Case XXIV, eight years after operation of heart disease.

Case XXVI, nine years after operation of tuberculosis.

Case XXV, eight years after operation of accidental burns.

Sixty-two cases are alive and well, and these with the four cases dead without recurrence, make 66 of the 83 cases, or 80 per cent., free from recurrence, and apparently up to the present time, at least, cured of their disease by a partial operation. The periods for which these 66 cases have been under observation are:

Up to 1 year	9 cases.
Up to 2 years	6 cases.
Up to 3 years	3 cases.
Up to 4 years	1 case.
Up to 5 years	5 cases.
Up to 6 years	9 cases.
Up to 7 years	5 cases.
Up to 8 years	4 cases.
Up to 9 years	3 cases.
Up to 10 years	4 cases.
Up to 11 years	4 cases.
Up to 12 years	3 cases.
Up to 13 years	1 case.
Up to 14 years	4 cases.
Up to 15 years	1 case.
Up to 16 years	3 cases.
Up to 17 years	1 case.
Total	66 cases.

A total of 476 years, and an average of 7.2 years each.

Thirteen cases (15.6 per cent.) showed sooner or later a return of the disease. In 5 cases the disease returned in the other breast, and in 8 cases it recurred on the same side, in the gland tissue remaining after the first partial operation. One patient died ten years after operation with a broken hip. Another five years after operation with a cerebellar endothelioma. In neither case was there evidence of any malignant process in the breast, though both were reported to have had recurrence of cysts. Four cases refused operation, and were reported living and well but with cystic disease present—one one year, and three five years after operation. The other seven were operated upon again, by amputation of both breasts in the greater number of cases, and reported well at intervals of ten, five, four, two, one and one-half years, seven months, and one month later.

Thus either recurrence of the cystic disease or carcinoma occurred in the breast first subjected to a partial operation in 12 cases out of the 83, or 14 per cent. In 16 cases, or 19 per cent., the patient failed to get permanent relief by the partial operation. In this connection it is of interest to note that in 19 of the 83 cases, or 23 per cent., the disease affected both breasts, although in a different degree. Of the 19, 14 had operative treatment on both breasts, and 5 had operation on one side alone.

A point to be considered in judging the value of the partial operation is the immediate result of operation and the rapidity of convalescence. It must be admitted that an operation which involves the healing of the fibrous tissue of the breast, after it has been united with buried sutures, takes more time and is attended by more sensitiveness than the elliptical amputation with removal of the whole gland. Sepsis is not greatly to be feared in either case unless a suppurative process is present in the ducts, a condition which occurs in a very small percentage of cases. We are in the habit of draining these wounds under any circumstances, because of the difficulty in controlling hemorrhage from the fibrous breast tissue. In spite of drainage, however, annoying hematomata have occurred in a few cases, and have required evacuation.

In favor of the partial operation can be adduced the strong sentimental feeling shown by women against the mutilation of an amputation. It has been said that consent to operative investigation of a breast tumor can more readily be obtained if the prospect is offered to the patient that she may not have to undergo the amputation. In our experience, however, the awakening public interest in cancer, and the more widespread knowledge of that disease, has provided a material argument in favor of radical operation, and few cases will be deterred on this account from accepting the best advised surgical relief at the present day.

In Dr. Warren's original description of the operation of plastic resection, the point was made that either one entire quadrant or the whole of the gland tissue could be removed by this method. The esthetic result is less satisfactory when the whole gland is removed, as there is not sufficient tissue available to make up the rounded configuration of the breast to its former degree of prominence. The scars, however, are distinctly less disfiguring after this operation than when elliptical amputation is done and the nipple removed. The complete removal of the gland tissue by the plastic resection incision we have called "subcutaneous amputation." It is a fact that in this series in not one of the 23 cases in which Dr. Warren himself performed the partial operation has recurrence taken place on the affected side. This is perhaps due to the discrimination used in applying the operation only to the less advanced and therefore more suitable cases of the disease. For such early and favorable cases the operation is to be preferred to local excision with its more evident and disfiguring scars.

For more advanced cases of cystic disease, either the subcutaneous amputation or a total amputation is to be preferred. Where considerable doubt exists as to the diagnosis between cystic disease and carcinoma, total amputation will be the operation of choice, as there is little doubt that the subcutaneous amputation in cancer cases would invite recurrence of the disease.

In our experience exploratory removal of a nodule, suspected

of being carcinoma, from the breast by local excision is a very dangerous procedure. We do not do this ourselves, but we have had a number of cases referred to us where such a local excision has been done by another surgeon, and we found that recurrence was almost inevitable, even when the local excision has been followed almost immediately by the most extensive and complete operation for cancer.

The safest way of exploring a breast tumor of doubtful diagnosis we believe to be by the removal of the entire breast, with the pectoral fascia, by elliptical amputation. The breast is then sectioned and frozen sections are made if necessary. If carcinoma is found the complete operation is performed. This procedure depends for its safety upon the fact that doubtful cases of cancer are early cases, and that in early cases extension beyond the confines of the breast itself may reasonably be expected not to have occurred.

Conclusions. 1. Of 83 cases of partial operation for cystic disease of the breast, 17, or 20 per cent., were unsuccessful.

2. In 4 cases carcinoma occurred in the breast tissue left by the partial operation—4.8 per cent.

3. In 5 cases the disease recurred only in the other breast—5.9 per cent.

4. In 8 cases the disease returned to the breast tissue left by the first partial operation—9.6 per cent.

5. The occurrence of carcinoma in cases of cystic disease, estimated at about 10 per cent. of all cases, demands radical treatment in all but the mildest cases.

6. The operation of choice should remove all of the gland tissue of the affected side, and, when the disease is bilateral, of both sides.

7. This can best be accomplished by "subcutaneous amputation," leaving the nipple and areola, or by elliptical amputation.

8. Where grave doubt as to diagnosis is present elliptical amputation is to be preferred.

9. Local excision of nodules in the breast, suspected of being malignant, should never be performed.

10. The operation of local excision or partial plastic resection should be restricted to the earliest and mildest types of cystic disease. In such cases plastic resection is the operation to be preferred.

ABSTRACT OF CASES

Case 1 (Dr. John Homans).—Aged forty-one years, married. Masses in both breasts of two years' duration. Slight pain. Operation: plastic resection, both breasts. Recurrence in one breast. Patient died ten years later with broken hip.

Case 2 (Dr. C. B. Porter).—Aged fifty-nine years, married. Duration one and one-half years. Tumor size of orange, left breast. Operation: excision. Well seventeen years later.

Case 3 (Dr. M. H. Richardson).—Aged forty-nine years, widow, no children. Duration, one and one-half years. Painful mass, size of an egg, in right breast. Operation: excision. Well sixteen years later.

Case 4 (Dr. F. B. Harrington).—Aged forty years, married. Duration, three months. Tumor size of a lemon. Operation: plastic resection. Well sixteen years later.

Case 5 (Dr. C. B. Porter).—Aged thirty-eight years, single. Duration, four months. Tumor size of an egg, outer half of left breast. Operation: excision. Well fifteen years later.

Case 6 (Dr. A. T. Cabot).—Aged forty-nine years, single. Duration, three months. Mass size of an egg in each breast. Operation: excision. Recurred four years later in the left breast. Recurrence excised. Well eleven years later.

Case 7 (Dr. J. C. Warren).—Aged forty-eight years, married, three children. Duration, six months. Tumor size of an egg, outer lower quadrant left breast. Operation; plastic resection. Well fourteen years later.

Case 8 (Dr. A. T. Cabot).—Aged thirty-six years, single. Duration, several years. Slight pain with periods. Mass size of an egg, outer upper quadrant left breast. Operation; plastic resection. Well fifteen years later.

Case 9 (Dr. J. C. Warren).—Aged forty-one, single. Tumor size of walnut, outer lower quadrant right breast, which varies in size and is slightly painful. Operation; plastic resection. Well fourteen years later.

Case 10 (Dr. A. T. Cabot).—Aged forty-three, single. Duration, two months. Slight pain. Tumor upper half right breast, size of a walnut. Operation: excision. Well fourteen years later.

Case 11 (Dr. S. J. Mixter).—Aged forty-nine years, married. Duration, eight months. Painful tumor, inner half of left breast, the size of a walnut. Operation: excision. Well fourteen years later.

Case 12 (Dr. A. T. Cabot).—Aged forty-nine years, single. Mass in the lower half of left breast. Slightly painful with periods. Operation: excision. Well thirteen years later.

Case 13 (Dr. F. B. Harrington).—Aged forty-seven years, married, one child. Duration, nine months. Slightly painful. Mass in the outer lower quadrant of both breasts, size of walnut. Operation: excision. Well twelve years later.

Case 14 (Dr. F. B. Harrington).—Aged forty-nine years, married. Duration, one and one-half years. No pain. Tumor size of egg in breast. Operation: plastic resection. Well twelve years later.

Case 15 (Dr. W. M. Conant).—Aged thirty-three years, single. Duration, one year. Mass the size of one-half lemon, in the lower half of left breast. Slightly painful, and yellowish discharge from the nipple at times. Operation: excision. Three years later reported ulcerated tumor of the breast, metastases in the axilla. Diagnosed as inoperable carcinoma.

Case 16 (Dr. J. C. Warren).—Aged forty-three years, married, five children. Duration, 2 months. Mass size of egg in the outer lower quadrant right breast. Operation: plastic resection. Eight years later reported with cysts in the other breast, but no operation was performed Well twelve years after the operation.

Case 17 (Dr. H. H. A. Beach).—Aged forty-seven years, single. Duration, eight months. Bloody discharge from the

nipple at times, and breasts somewhat painful. Tumor in the outer upper quadrant left breast, and similar tumor in the right breast. Excision of mass of left breast, and amputation of right breast. Died of sarcoma of the mouth six years later.

CASE 18 (Dr. J. C. Warren).—Aged thirty-seven years, married, no children. Duration, five months. Some change in size with periods. Diffuse masses in both breasts. Operation: plastic resection. Well twelve years later.

CASE 19 (Dr. J. W. Elliot).—Aged thirty-two years, single. Duration, six weeks; no pain. Mass the size of egg, upper outer quadrant left breast. Operation: excision. Well eleven years later.

CASE 20 (Dr. M. H. Richardson).—Aged fifty-four, married. Duration, two weeks. A slightly painful tumor, size of walnut, upper outer quadrant, right breast. Operation: excision. Well twelve years later.

CASE 21 (Dr. J. W. Elliot).—Aged forty-six years, married, three children. Duration, two weeks. Small tumor in lower outer quadrant, right breast, not painful. Operation: excision. Well eleven years later.

CASE 22 (Dr. R. B. Greenough).—Aged twenty-two years, single. Two slightly painful tumors in outer half right breast, size of walnuts. Pain somewhat worse with periods. Operation: plastic resection. Well two years later.

CASE 23 (Dr. J. C. Warren).—Aged forty-two years, single. Duration, four months. Two slightly painful tumors in each breast, size horse chestnut. Operation: plastic resection, both breasts. Well ten years later.

CASE 24 (Dr. W. M. Conant).—Aged thirty-five years, widow, no children. Duration, two months. Tumor size of horse chestnut in lower outer quadrant of left breast, not painful, but varying somewhat in size. Operation: excision. Died eight years later with heart trouble. No recurrence.

CASE 25 (Dr. W. M. Conant).—Aged forty-two years, married, three children. Duration, two months. Tumor in upper outer quadrant right breast, size of lemon, not painful. Operation: excision. Well ten years later.

Case 26 (Dr. J. C. Warren).—Aged forty-one years, married, three children. Diffuse masses in both breasts, not tender, some discharge from nipple. Operation: plastic resection, both breasts. Well nine years later.

Case 27 (Dr. J. C. Warren).—Aged forty-seven years, married. Duration, two and one-half months. Slightly painful tumor in upper inner quadrant right breast. Operation: plastic resection. One year later patient had small tumor in the other breast. No operation was performed.

Case 28 (Dr. J. C. Warren).—Aged fifty years, married. Duration, four months. Slightly painful tumor in the lower half of right breast. Operation: plastic resection. Well ten years later.

Case 29 (Dr. W. M. Conant).—Aged forty-three, single. Duration, five months. A slightly painful tumor in the upper inner quadrant of right breast, size of lemon. Operation: excision. Well nine years later.

Case 30 (Dr. J. W. Elliot).—Aged forty-six years, married, six children. Duration, three weeks. Slightly painful diffuse mass occupying a large part of left breast. Operation: excision. One year later patient entered the hospital with recurrence in other breast. There were two small tumors in the outer hemisphere of the left breast. These were excised. No recurrence in either breast five years later.

Case 31 (Dr. W. M. Conant).—Aged twenty-two years, married. Six years previously (at age of sixteen) operation for "cystic hygroma" of left neck, axilla, and breast. Duration, one month. Diffuse masses in both breasts, no pain. Operation: plastic resection of left breast; right not operated upon. One year later patient reported with an ulcerated tumor of the left breast, and palpable glands in the axilla. Pathological examination of specimen removed showed adenocarcinoma. The condition was deemed inoperable.

Case 32 (Dr. J. C. Warren).—Aged forty-eight years, single. Duration, three months. A tumor size of egg in upper inner quadrant left breast, not painful. Operation: plastic resection. Well ten years later.

Case 33 (Dr. J. C. Warren).—Aged thirty-six years, single. Duration, one week. A slightly painful tumor in the upper outer quadrant of left breast, size of a plum. Operation: plastic resection. No recurrence in this breast ten years later, but two masses the size of an almond in the other breast.

Case 34 (Dr. J. C. Warren).—Aged thirty years, single. Duration, five days. A slightly painful tumor in the lower outer quadrant of right breast. Operation: plastic resection. Well three years later.

Case 35 (Dr. M. H. Richardson).—Aged thirty-two years, married, four children. A mass the size of a small egg in the outer half of the left breast. Breast painful during the catamenia. Operation: excision. Well eight years later.

Case 36 (Dr. J. C. Warren).—Aged thirty-five years, single. Duration, one and one-half months. Tumor in the upper inner quadrant of right breast, varied somewhat in size, but was not painful. Clear discharge from the nipple at times. Operation: plastic resection. Well eight years later.

Case 37 (Dr. D. F. Jones).—Aged forty-four years, married, two children. Duration, one week. Tumor size of an egg in the upper outer quadrant of right breast. Operation: plastic resection. Well eight years later.

Case 38 (Dr. D. F. Jones).—Aged forty-two years, married, three children. Duration, six months. Diffuse mass occupying large part of the left breast, slightly painful, and with a serous discharge from the nipple at times. Operation: plastic resection. Six months later patient reported with a continuation of the discharge from the nipple, but refused operation. Four years later recurrence of cysts in left breast. Eight years after operation patient died with carcinoma of both breasts, and metastases in the axillæ, spine, etc.

Case 39 (Dr. C. A. Porter).—Aged forty-nine years, widow, no children. Tumor size of an almond in outer half of left breast. Operation: excision. Well seven years later.

Case 40 (Dr. J. C. Warren).—Aged forty-three years, single. Duration, three years. Slightly painful tumor in the inner half

of right breast which varies somewhat in size. Operation: plastic resection. Well six years later.

Case 41 (Dr. J. C. Warren).—Aged twenty-seven years, single. Tumor in the upper outer quadrant of right breast. Slight pain which was increased during catamenia. Tumor also varies in size with periods. Operations: plastic resection. Well six years later.

Case 42 (Dr. R. B. Greenough).—Aged forty-eight years, married. Duration, two years. Tumor the size of walnut in the inner lower quadrant of right breast. Discharge from nipple. Operation: plastic resection. Welll seven years later.

Case 43 (Dr. Hugh Williams).—Aged forty-two years, single. Duration, three weeks. Painful tumor size of walnut in upper outer quadrant left breast. Operation: excision. Well seven years later.

Case 44 (Dr. J. C. Warren).—Aged forty-seven years, married, one child. Duration, ten days. A mass the size of an egg in the outer half of right breast, not painful. Operation: plastic resection. Well seven years later.

Case 45 (Dr. J. C. Warren).—Aged forty-five years, married, no children. Duration, six months. A painful indefinite mass in the outer half of left breast. Operation: plastic resection. Well two years later, but occasionally has slight neuralgic pain in breast.

Case 46 (Dr. J. C. Warren).—Aged forty-three years, married, two children. Duration, three and one-half years. Two masses, size of an egg, in upper outer quadrant right breast. Operation: plastic resection. Well six years later.

Case 47 (Dr. F. G. Balch).—Aged seventy years, married. Duration, one month. Tumor size of plum, inner lower quadrant left breast. Operation: excision. Well six years later.

Case 48 (Dr. J. C. Warren).—Aged forty-three years, married. Duration, four months. Small tumor inner lower quadrant left breast, painful at time of periods. Operation: plastic resection. Well six years later.

Case 49 (Dr. J. C. Warren).—Aged forty-six years, single. Duration, two weeks. Painful tumor inner half of left breast. Operation: plastic resection. Well six years later.

Case 50 (Dr. J. C. Warren).—Aged forty-nine years, married, several children. Small mass upper outer quadrant left breast. Operation: plastic resection. Well six years later.

Case 51 (Dr. C. L. Scudder).—Aged forty-three years, single. Duration, one year. A painful mass upper outer quadrant left breast. Operation: excision. Five years later patient reported that a small tumor had recurred in the left breast.

Case 52 (Dr. C. L. Scudder).—Aged twenty-four years, married, one child. Tumor in upper outer quadrant left breast. Operation: plastic resection. Well five years later.

Case 53 (Dr. F. G. Balch).—Aged forty-five years, widow. Duration, ten years. Mass the size of an egg in the upper portion of each breast. Operation: excision. Well five years later.

Case 54 (Dr. C. A. Porter).—Aged twenty-four years, married. Duration, one year. Small tumor in the upper outer quadrant left breast. Painful at time of periods. Operation: plastic resection. Well five years later.

Case 55 (Dr. J. C. Warren).—Aged forty-three, single. Duration, few days. Mass the size of walnut outer portion of right breast, not painful. Operation: plastic resection. Well five years later.

Case 56 (Dr. R. B. Greenough).—Aged forty-one years, married, four children. Duration, three months. A non-painful mass, lower outer quadrant right breast, size of a pea. Operation: plastic resection. Four years later patient returned with a palpable nodule in the axillary border, which on removal proved to be carcinoma. A complete operation was done, with removal of breast, both pectoral muscles, and axillary contents. Well two years later.

Case 57 (Dr. F. G. Balch).—Aged forty-six years, married, eight children. Duration, two months. Mass size of an egg in the upper outer quadrant of left breast. Operation: excision. Well four years later.

CASE 58 (Dr. C. C. Simmons).—Aged thirty-nine years, single. Duration, three months. Tumor size of a bean upper outer quadrant of right breast. Operation: plastic resection. Well five years later.

CASE 59 (Dr. C. C. Simmons).—Aged forty years, widow. Duration, two weeks. Two small slightly painful masses in the outer half of right breast. Operation: plastic resection. Well two years later.

CASE 60 (Dr. R. B. Greenough).—Aged forty-one years, single. Duration, in the right breast, eight years; in the left, two years. Diffuse masses in both breasts, the larger being the upper outer quadrant of right. These changed in size with periods, but were not painful. Right breast had local excision in California eight years before, and recurred ten years later. Operation: plastic resection, left breast. Well four years later.

CASE 61 (Dr. Hugh Williams).—Aged forty-four years, married, one child. Duration, four years. Small painful tumor in upper outer quadrant left breast. Operation: plastic resection. Well three years later.

CASE 62 (Dr. R. B. Greenough).—Aged forty-nine years, married, one miscarriage. Duration, two years. Mass size of an apple in upper outer quadrant of right breast, painful at time of periods. Operation: plastic resection. Well three years later.

CASE 63 (Dr. J. G. Mumford).—Aged fifty years, married, one child. Duration, four months. Tumor size of an egg occupying centre of left breast. Operation: plastic resection. Well two years later.

CASE 64 (Dr. C. C. Simmons).—Aged forty-seven years, married, eight children. Duration, three months. Painful tumor, size of filbert, upper inner quadrant right breast. Operation: plastic resection. Well one year later.

CASE 65 (Dr. C. C. Simmons).—Aged forty-four, married, no children. Duration, six weeks. Slightly painful mass in lower inner quadrant left breast. Operation: plastic resection. Well two years later.

Case 66 (Dr. R. B. Greenough).—Aged thirty-four years, married, no children. Duration, three months. Slightly painful mass in upper outer quadrant left breast, size of walnut. Operation: plastic resection. Two years later patient reported with a cyst in the upper outer quadrant of the other breast, which was excised. The right breast at this time showed no recurrence.

Case 67 (Dr. R. B. Greenough).—Aged forty-seven years, married, two children. Duration, one year. Painful tumor, size of a walnut upper inner quadrant left breast. Operation: plastic resection. Well one year later.

Case 68 (Dr. R. B. Greenough).—Aged forty years, single. Duration, six months. Small tumor in upper outer quadrant left breast, which is slightly painful. Operation: excision. One and one-half years later several indefinite masses had recurred in the right breast, and also in the left. Subcutaneous amputation of both breasts was done. Patient well one year later.

Case 69 (Dr. R. B. Greenough).—Aged forty years, married. Duration, one year. Tumor in upper outer quadrant left breast size of an egg, slightly painful. Operation: plastic resection. Seven months later mass recurred with diffuse fibrous thickening. Amputation performed. Well seven months later.

Case 70 (Dr. C. C. Simmons).—Aged thirty-two, married, two children. Duration, three months. Slightly painful tumor in upper outer quadrant left breast, size of walnut; this varied somewhat in size. Operation: plastic resection. Well two years later.

Case 71 (Dr. R. B. Greenough).—Aged thirty-nine years, married. An indefinite thickening of upper quadrant right breast, slightly painful during periods. Duration, two years. Operation: plastic resection. Well ten months later.

Case 72 (Dr. R. B. Greenough).—Aged thirty-six years, married, several children. Tumor, size of walnut, upper outer quadrant right breast, which was slightly painful and which varied in size somewhat. Operation: plastic resection. Well ten months later.

Case 73 (Dr. R. B. Greenough).—Aged twenty-nine years, single. Duration, four years. Many diffuse masses in both breasts, varying in size up to a walnut, which were slightly painful at time of periods. Operation: plastic resection of the right breast; excision of mass in left breast. Ten months later slight recurrence felt in both breasts.

Case 74 (Dr. R. B. Greenough).—Aged thirty-five years, single. Duration, two weeks. Slightly painful mass, size of an egg, occupying centre of right breast, and a small one in upper outer quadrant of left breast. Operation: plastic resection of right breast. Seven months later right breast was normal, but the left showed several indefinite cystic masses.

Case 75 (Dr. C. C. Simmons).—Aged thirty-seven, married, two children. Slightly painful tumor, one and one-half inches in diameter, outer lower quadrant left breast. Operation: plastic resection. Six months later no recurrence, but patient complained of neuralgic pain.

Case 76 (Dr. C. C. Simmons).—Aged forty-two years, married, one child. Duration, one month. Painful tumor, size of an egg, upper outer quadrant left breast. Operation: plastic resection. Well five months later.

Case 77 (Dr. J. C. Warren).—Aged forty-six years, married, one child. Duration, two days. Tumor, two inches in diameter in lower portion of right breast. Operation: plastic resection. Well eleven years later.

Case 78 (Dr. Hugh Cabot).—Aged forty-nine years, widow, two children. Duration, six weeks. Slightly painful tumor occupying centre of left breast two inches in diameter. Operation: plastic resection. Well six years later.

Case 79 (Dr. F. G. Balch).—Aged forty-six years, married. Duration, eight months. Multiple cystic masses felt in both breasts, larger in the left, however, than the right. Some discharge from the nipple. Operation: on left breast subcutaneous amputation; on right, excision. Well seven years later.

Case 80 (Dr. R. B. Greenough).—Aged forty-seven years, single. Duration, two weeks. Diffuse painful masses in both

breasts. Operation: plastic resection of both breasts. Patient died five years later with endothelioma of brain (autopsy); at that time was reported to have had recurrence in right breast, none in left.

Case 81 (Dr. R. B. Greenough).—Aged thirty-four years, single. Duration, three weeks. Painful tumor size of an egg in upper outer quadrant right breast; palpable cysts in left. Operation: plastic resection of right breast. Six months later reported with recurrence in right breast. Both breasts were then amputated.

Case 82 (Dr. E. A. Codman).—Aged fifty years, widow, five children. Duration, two years. Multiple small cystic tumors, palpable in both breasts, somewhat painful. Operation: on right breast, amputation; left breast, excision of one-half. Well thirteen months later.

Case 83 (Dr. C. L. Scudder).—Aged forty years, married, four children. Duration, six weeks. Painful tumor, one inch in diameter, occupying centre of left breast. Operation: plastic resection. Well ten and one-half years later.

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DISCUSSION

Dr. J. M. T. Finney, Baltimore.

In my own experience in private practice by far the most frequent pathological condition of the breast for which I am consulted is cystic disease. This is not true in dispensary cases, where inflammatory diseases are more common. This question is important from several stand-points, from its relationship to carcinoma as an etiological factor. I think Dr. Greenough's estimate in the percentage of cases is not overdrawn; I cannot entirely agree with Dr. Bloodgood, who places a much higher percentage; my own experience is rather lower than that of Dr. Greenough, but there is no doubt that this condition is an etiological factor of importance in carcinoma. The diagnosis is comparatively easy. This disease is one of earlier life than is usually supposed. I have found it not infrequently in the late twenties and early thirties. The usual symptom that brings patients is pain. In these days of the carcinoma propaganda, people are usually alarmed very easily, and recently my experience has been that I have been consulted by an unusual number of women for pain in the breast. Examination has shown the usual symptoms described by Dr. Greenough. What are we to do in such cases? It is a very serious question. If this is a disease which is followed by carcinoma in a large percentage of cases are we not in just the same position as in relation to gastric ulcer, for instance? If we know that we are dealing with a condition which in a large percentage of cases is followed by carcinoma, are we justified in temporizing, or should we advise more radical treatment? That is a question which has given me no little concern. In the second place, this disease is a protest against certain practices that obtain in modern civilization. In going over my cases very carefully I find that the class of women who are affected with this trouble are in the majority of cases from that group of women who are married and childless. Next to that are the women who are married, have had one or two children, but have not nursed them. After that comes the unmarried woman. The mothers of ten or twelve children, who have nursed them all, are exempt in my experience. I feel that this is a condition which is a real menace, and which one must carefully examine and study as regards the treatment, because that is the important question, not the diagnosis, which is usually easy. The treatment must depend largely upon more careful study of our cases. The reports of McCarthy are most interesting. It seems to me they

are open to the same objection that obtains to the reports of the study of cases of very early forms of carcinoma. What is carcinoma? Is a single cell nest a carcinoma? In examining the edges of ulcers, take the familiar leg ulcer for example, which has the histological picture of epithelioma absolutely, with one exception, which is that there is a slight zone of round-cell infiltration about it, unless one is careful to observe that zone, one will call a perfectly benign, indolent ulcer an epithelioma. Dr. McCarthy's studies are most interesting and instructive, but are a little in advance of the ordinary ideas and knowledge obtaining as to this condition.

I believe that if you operate at all one should give the patient the benefit of the doubt and do the complete operation. The palliative operations are hardly justifiable as a general rule. My experience is that nowadays it is very easy to get a woman to consent to any operation that offers her a reasonable immunity from further trouble. The idea of mutilation if the condition is properly explained does not count for much. If one operates at all, and the question must remain an open one, one should, as a rule, operate by removing the entire gland. Partial removals are at times justifiable, but only in carefully selected cases.

Dr. Albert J. Ochsner, Chicago.

There are several features in this subject which it seems to me should be very thoroughly emphasized. In my own experience malignancy followed this condition in about 4 per cent. of cases. According to the law of probabilities there will be a large proportion of carcinoma cases if we do a partial removal and we change a carcinoma case in its most hopeful stage into a carcinoma case that does not promise very much. In other words, we have in carcinoma of the breast a probability of successful surgical treatment in that class of cases in which the tumor at the time of operation is circumscribed; these cases of cystic disease of the breast form a large proportion of such cases. We have the development of carcinoma as a result of long-standing irritation. This long-continued irritation seems to prepare the tissues, as Dr. Mayo said in his address yesterday, for the carcinoma infection. In many cases there is later on an acute irritation which gives this infection an active start. In the cases under my observation that acute irritation was furnished by the operation. In the first case of this kind which I observed while an assistant to Nicholas Senn, none of us had the slightest idea that there was any malignancy until the specimen was carefully sectioned, when we found an absolutely positive carcinoma the size of a large bird-shot, yet so small that it would have been the merest accident had it been

found at an immediate examination; in other words, had we removed a specimen for immediate microscopic examination we would have been certain to have missed this portion, which was the only portion in the whole breast showing malignancy, and the pathologist would have returned a negative diagnosis. Consequently, I think I can fully agree with all of Dr. Greenough's conclusions. But in particular I wish to emphasize that no specimen for microscopic examination should ever be removed before the operation for the purpose of diagnosis, because in all of my experience I have never encountered a case of carcinoma of the breast in which a specimen was removed for examination in which the carcinoma did not kill the patient.

Dr. Charles H. Mayo, Rochester, Minnesota.

I want to express my approval of the Warren operation. Organs such as the breast, the uterus, and the prostate, which must undergo a natural degeneration, are highly susceptible to malignancy. In operating on the woman's breast for benign conditions one should consider the question of mutilation insofar as it does not interfere with efficiency. The Warren operation can be done with but little mutilation. Again, if in some cases the patient is worried over the deformity a large mass of fat with pedicle may be rolled up from the abdominal wall to build up a new breast. Occasionally we find cancer developing in the scars of abscesses from lactating breasts. When operating to remove simple tumors of the breast I always have a fear that malignancy may later occur in the scar. This local removal of tumors from the gland may develop a potential danger from scar tissue.

I believe that if the principles of the Warren operation were better understood by the laity, women would come at an earlier period for operation without the fear of mutilation, and we could thus discover many cases of cancer at an early period and make radical operations when indicated.

Dr. C. B. G. de Nancrède, Ann Arbor.

I practise in a section of the country where carcinoma of all organs is extremely common. I used to try conservative measures for certain mammary tumors, confiding a little more in my absolute skill in diagnosis than I do at present. I have seen many cases which I have thought to be benign, which I have believed by their course must have been benign for years, and then for some reason I have had to operate and have found them malignant in addition to a benign condition easy to demonstrate. Again, I have seen so many cases of late where I have been in grave doubt whether I ought not to do

a partial and not a radical operation: then for good reasons I have performed the radical operation, when examination of all parts of the specimen has somewhere shown undoubted carcinoma present; hence I want to range myself with those who would rather err on the side of radical work than on the side of conservatism. It is too important a matter: life as compared with sentiment. I have seen a great many cases, that I am perfectly sure for many years were benign, proved histologically to be so later, when the diseased area only was examined, *i. e.*, what could be felt at the operation where, in the remainder of the breast when subjected to careful histological examination, one or more areas of undoubted carcinoma were detected. In my experience I am afraid of the partial operation; in any woman who has passed the child-bearing period I rarely hesitate to advise a radical operation, and again and again when I have hesitated to give that advice the microscope has demonstrated that I should not have hesitated. I do not believe the majority of us can make these invariably certain differential clinical diagnoses in diseases of the breast, although in many cases this is possible.

Dr. N. B. Carson, St. Louis, Missouri.

I have listened with much interest to Dr. Greenough's paper, as I have had considerable experience with cystic disease of the breast, and I cannot now recall a single case in which I did the "partial operation," that I have been able to follow, in which the case did not return later to have the radical operation done for cancer. I have had some cases which at the time of operation were of a doubtful character; in these cases I gave the patient the benefit of the doubt and did the complete operation. I agree with Dr. Ochsner, when he says that he believes that possibly the partial operation in these cases stimulates the change to malignancy which sometimes comes later. I call to mind two such cases, one a married woman from whom I removed a large single cyst, which was pronounced non-malignant by a well-known pathologist. In a short time I had to remove the entire breast on account of malignancy, and she eventually died of general carcinoma. Another was that of a young woman from whom I removed a small cyst, which was pronounced, upon examination, to be simple; later a similar cyst developed at the same site, which I also removed and which, upon examination, was found to be malignant. She would not consent to a radical operation. I have lost sight of her.

Within the last year I operated on one of the nurses of our hospital, about twenty-one years of age. I did the partial operation, but there was something about the appearance of the tumor after removal which

attracted my attention, and made me suspect malignancy. I submitted parts of the tumor to two pathologists, with the request that they give me a prompt return. Both, independently, pronounced it malignant, and I immediately did a complete operation. Later a doubt arose in the mind of one of the examiners as to the correctness of his diagnosis, and although experts have examined sections since then, the exact nature of the growth at last accounts had not been determined.

As to the value of examinations made by frozen sections, I have always been very doubtful, for the reason that several times I have been led into error by the reports made in this way. I have recently had a case similar to the one cited by Dr. Ochsner in which there was only a small nodule. Upon my first examination of this case, and just before I had completed it, and was about to tell the patient that she had what I considered a simple non-malignant tumor, I discovered a little nodule not bigger than a pea and as hard as a rock. I advised a complete operation, which was done later. This specimen went to the pathological department of the Washington University, where all specimens from the Mullanphy Hospital are sent, and was there examined by several pathologists, who all pronounced it non-malignant, and just as it was about to be put away finally a little nodule was discovered, which upon section was found to be malignant. If an examination had been made of this case at the time of operation I am sure that this little nodule would have escaped notice, as all the chances are against the discovery of a nodule of this kind, in a hurried examination, and I am quite certain that there are many cases of small cancerous nodules which are overlooked in examinations made at the time of the operation, and when they come back later with the return of the disease, it is concluded that the tumor had undergone a change to malignancy, when in reality it was present at the time of removal.

In conclusion, let me say that my experience with cystic disease of the breast has led me to hesitate to advise the partial operation in any case, although we may have the assistance of a skilled pathologist to make an examination and report before the operation is completed.

Dr. R. B. Greenough, Boston (in closing).

I have experienced some of Dr. Finney's difficulties in determining how best to handle the lesser degree of this disease, especially in younger women. In my opinion the disease is of far less consequence in women between twenty and thirty years than in the two following decades. It is my belief that in women from thirty to fifty years of age radical removal of the affected gland tissue is the safe procedure.

LIGATION OF THE INNOMINATE ARTERY. REPORT OF A SUCCESSFUL CASE

By CARL A. HAMANN, M.D.
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Consideration of the infrequency of ligation of the innominate artery has led the writer to place upon record the history of the following case:

Mrs. K., aged sixty-eight years, referred by Dr. H. H. Webster, presented herself on January 11, 1913, complaining of severe pain about the right shoulder and in the right arm, and of a pulsating swelling above the clavicle.

She had always been a hard working woman, had not been addicted to the use of alcohol and there was no history of lues nor could there be found any evidence that there had ever been a luetic infection, though a Wassermann test was not made.

Her present trouble was noticed a month or six weeks before coming under observation, pain and difficulty in using the right arm being the first disturbance. Early in January, 1913, she detected the pulsating swelling.

Physical examination did not reveal any pathologic condition except a moderate arteriosclerosis and the enlargement above the right clavicle. The swelling, which was about the size of a hen's egg, presented all the characteristics of an aneurysm of the subclavian artery. There was no apparent disturbance of the circulation in the arm, except the pain and certain paresthesiæ; no evidence of nerve lesions beyond what could be accounted for by the pressure of the aneurysmal sac on the brachial plexus.

She was at first treated by keeping her in bed, on a reduced

diet, with limitation of the amount of liquid ingested and the administration of small doses of iodide of potassium.

On February 6, 1913, an attempt was made to insert fine silver wire into the sac; only about 8 inches of wire could be passed, however. This was cut off flush with the skin and has of course remained *in situ*.

No improvement in the local condition was effected and on February 10, 1913, she was operated upon, under ether anesthesia.

An incision was made along the anterior border of the sternocleidomastoid down to the sternoclavicular articulation, and another one along the clavicle; the triangular flap of skin, superficial fascia and platysma was dissected up; after division of the deep fascia, severing the origin of the sternomastoid muscle and clearing away some of the loose fat, a good exposure of the aneurysm and the deeper structures was obtained. The aneurysm involved the third part of the subclavian artery, extending, however, behind the scalenus anticus muscle and encroaching upon the first part of the subclavian. It was accordingly deemed unsafe to apply a ligature to the first part of the subclavian and ligation of the innominate was decided upon.

The sternohyoid and sternothyroid muscles were severed and raised upward; about 2 inches of the clavicle were resected and the innominate artery was readily exposed. A heavy, braided double silk ligature was placed around this vessel, about $\frac{1}{2}$ inch below the bifurcation, and tied with an ordinary surgical knot; as the knot was being tied the coats of the vessel could be distinctly felt to give way, though only very moderate force was used; evidently the vessel wall was markedly atheromatous. Pulsation of the sac at once ceased completely. The common carotid was also tied, about one inch above its origin, with No. 2 chromicized catgut. The wound was accurately closed, except for a small drainage opening at the inner angle, and the dressings so applied as to obliterate dead spaces. The arm was wrapped in cotton. The patient made no complaint of coldness of the limb subsequent to the operation, and there was no edema or disturbance of the nutrition. The wound healed by first intention.

There was at no time any evidence of disturbed cerebral circulation. The sac rapidly became consolidated and firm. Some pain and paresthesia persisted for several weeks.

On June 29, 1913, it was noted that but little trace of the aneurysmal sac could be felt; there was no pulsation of the radial or brachial arteries; the hand was colder than the left and the skin of the palm apparently smoother and somewhat atrophic. There was some pain about the end of the clavicle, probably due to the adherent scar.

The patient was examined thirteen months after the operation and found to be in good general health; her weight has increased, she works every day, and has no pain. No trace of the former aneurysm can be felt, and the radial pulse is absent; there still seems to be some paresthesia of the forearm and fingers. An examination of the chest fails to reveal any evidence of an aneurysm of the arch of the aorta or any of its branches.

Observations on the blood-flow in the upper extremities were made by Prof. G. N. Stewart.[1] A note from him is as follows: "The blood-flow in both hands in Mrs. K., is greater on July 9, than at the previous examination (March 20 and March 21). The ratio of the flow in the right to that in the left hand is 1 to 1.3 on July 9, while at the previous examinations it was 1 to 3.5. The relative increase has therefore been much greater in the right than in the left. Immersion of the left hand in cold water causes now a marked diminution in the flow in the right, indicating that an appreciable (and no doubt the greater) part of the total resistance of the path is now in the smaller vessels of the anterior limb. The arterial channels feeding the arm are therefore now comparatively wide. The flow in the right is absolutely as great (over 8 grams per 100 c.c. of hand per minute with room temperature 26° C.), so that the symptoms now observed in the hand cannot be due to the small blood-flow."

As is well known, the innominate artery was first ligated by Valentine Mott in 1818. Sheen,[2] in 1905, collected 36 cases, including one of his own, and Burns,[3] in 1908, collected 10 more cases (one of them his own), bringing the number up to 46. I

have been able to find references to the following additional instances: Myles,[4] one case (unsuccessful), Saigo,[5] two cases (successful), Ballance[6] two cases (one successful), Sargent[7] one case (successful). These, together with my own case, bring the number up to 53, of which 14 were successful (26.4 per cent.). Only one of the recoveries, that of Smythe, dates from pre-antiseptic times. Tables are given by Sheen and Burns showing details of the cases up to 1908.

Allan Burns in 1811 demonstrated that the vessels of the head and the right arm could be fully injected after ligation of the innominate artery in the cadaver, and in looking over the published cases of the ligation of this vessel during life, no instances of gangrene could be found, though disturbance of the cerebral circulation occurred a number of times.

The most common cause of death has been secondary hemorrhage, which occurred in one instance as late as the sixtieth day after operation; this can be readily understood, as the majority of operations were done in pre-antiseptic days; however, secondary hemorrhage is still a large factor in the mortality record of the more recent cases.

The cases above referred to are, of course, very unequal in value for forming an idea as to the advantages and disadvantages of ligating the innominate artery and in deciding which plan of procedure is to be adopted in a given case. Most of the operations were done in pre-antiseptic times; the position and size of the aneurysm was quite variable; in some a greater or lesser degree of arteriosclerosis existed; the ligature material varied; other vessels, such as the common carotid and vertebral, were frequently tied in addition; in two instances, at least, the aneurysmal sac was extirpated after the ligation of the innominate for return of pulsation.

For the cure of aneurysm of the right subclavian artery, which is the most common indication for the ligation of the innominate, some eighteen different operative procedures have been practised according to Jacobsthal;[8] to these may now be added the Matas method.

It is not the purpose of the present writer to discuss these methods. Cures have been accomplished by most or all of them, but it cannot be said definitely which is the method of choice. It may be noted that peripheral ligation has proven quite successful; Savariaud[9] has collected nine cases, all followed by recovery. It is the opinion of many writers that extirpation of the sac is the ideal method; both extirpation and the obliterative method of Matas are based upon the underlying principle, established by Antonio Scarpa that the artery should be obliterated at the site of the aneurysm. However, there are cases in which these methods can for some reason or other not be adopted and ligation of the innominate, which is now established as a feasible and reasonably successful operation, will have to be resorted to.

A few details in the performance of the operation may be briefly alluded to.

To gain access to the vessel, an incision along the anterior border of the sternomastoid, joined by another over the clavicle, has been the one most frequently adopted; the flap having been dissected up, the attachments of the sternomastoid are divided and also those of the sternohyoid and sternothyroid; the common carotid having been exposed, it is followed to its origin from the innominate. Ordinarily, the bifurcation is high enough to enable one to reach the vessel without removal of bone; however, excision of the inner part of the clavicle will materially aid in exposing the vessel and in giving more room for the deeper dissection. Milton[10] proposed longitudinal division of the sternum and forcible separation of the two parts in order to gain access to the anterior mediastinum; this seems to me an unnecessarily severe procedure, at any rate for ligation of the innominate. Bardenheuer recommended osteoplastic resection of the manubrium; the flap is hard to make, however, and is apt to suffer in its nutrition and necrosis may result. Removal of the right half of the manubrium and adjoining costal cartilages, and perhaps also the inner end of the clavicle, may be resorted to.

In clearing the artery injury to the innominate veins, the vagus and the pleura must be carefully avoided; and this is best accomplished by keeping close to the common carotid and innominate arteries and gently displacing the structures mentioned.

There has been considerable discussion concerning the character of ligature material to be used, the kind of knot to employ, whether to use two separate ligatures, a short distance apart, how firmly to tie them and whether or not the common carotid and other vessels should also be tied.

Provided rigid asepsis be maintained, it probably makes little or no difference what ligature material is employed; personally, I believe, that the ligature should be tied firmly enough to divide the inner coats and that the common carotid should also be tied, and perhaps the vertebral, as it is reasonable to assume that thus a return of pulsation in the aneurysmal sac will be more likely avoided.

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THE TECHNIQUE OF INTRATHORACIC OPERATIONS

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Although the technique of intrathoracic surgery has been very much improved during the last few years, complications still often follow upon operations on the lungs, the esophagus, and the heart. For this reason the technical details, by means of which intrathoracic operations may be rendered more safe, must be worked out. The purpose of this paper is to describe the methods by which the occurrence of pleurisy and of air emboli of the coronary arteries can be prevented.

It is probable that the development of pleurisy is always due to infection or irritation produced by the handling of the pleura with sponges or instruments, by the contact of the blood, or by the germs of the air. Most experimenters and surgeons in their operations on the pleura employ the same technique which is used in abdominal surgery. They do not realize that the pleura is very much more liable to infection than the peritoneum, and that the mechanical irritation, as well as certain factors of infection, such as the atmospheric germs, are possibly able to produce dangerous complications. Several years ago I read a paper before the members of this Society in which that question was already investigated and in which the details of a technique for the prevention of these mild but very dangerous infections was described. At that time great care was taken in handling the intrathoracic organs, in sponging and walling-off the operating field with gauze, and in protecting the pleura

from the various factors which bring about irritation and infection. As soon as the thoracic cavity was opened the lungs were covered with fine silk compresses impregnated with vaselin. The silk tissues acted as a thin and almost impermeable membrane, which protected the pleura without irritating it and permitted a very efficient walling-off of the operating field to be effected. At the same time it prevented the evaporation and the desiccation of the surface. Of twelve animals operated upon at that time all twelve recovered. Nevertheless, after more complicated operations, such as the patching of the vena cava, the grafting of vessels on to the heart, some simultaneous operations on the heart and descending aorta, it was observed, when a large exposure of the thoracic cavity was rendered necessary, that serofibrinous or purulent pleurisy was eventually present. In twenty-eight operations of this class which were performed these complications occurred seven times.

Although these experiments were made a long time ago, it appears that the technique for the prevention of pleurisy has not been further developed as yet. Both American and European surgeons are still describing more or less complicated methods for the drainage of the pleura. This evidently shows that pleurisy is still an ordinary complication accompanying intrathoracic operations. For this reason I have again attempted to ascertain whether in experimental operations this complication could be entirely avoided.

The use of Japanese silk towels impregnated with vaselin had already in a large measure diminished the danger of the occurrence of pleurisy; but it was nevertheless probable that the silk membrane did not sufficiently protect the remoter parts of the pleural cavity. Moreover, when hemorrhage occurred the blood flowed along the greased surface of the pad and accumulated in the lower part of the thoracic cavity. For this reason the technique had to be modified, and this was effected in the following manner. The operating field was walled-off by two kinds of towels. The first kind was made of Japanese silk which had been previously boiled in water, dried, and

sterilized in the autoclave, like ordinary pieces of dressing. The second kind of towel was composed of absorbent cotton and of black Japanese silk. These towels were made in the following way: Two pieces of fine black Japanese silk were sewed together at the edges. Between these two pieces was placed a layer of absorbent cotton about 1 cm. thick, and the whole towel was knotted throughout, thus forming a pad. These towels were sterilized in the autoclave. Both kinds of towel above described were used for walling-off the operating field. When the incision of the superficial part of the thoracic wall was completed and the hemostasis secured the pleural cavity was opened by means of a small incision made in the middle of an intercostal space. A dry, white Japanese silk towel was introduced into one end of the incision, while a second one was introduced at the other end. These towels afterward served as a protection to the anterior and posterior parts of the pleural cavity. Next, the incision of the thoracic wall was completed and the thoracic cavity was opened wide, the lungs being meanwhile completely protected by the towels already introduced. Immediately after this the black silk-and-cotton-padded towels were laid on the upper and lower edges of the wound and introduced into the cavity in such a manner that they respectively protected the upper and lower parts of the pleura. Next, a Gosset retractor was applied and the edges of the wound were retracted as much as was necessary for the purpose of the operation. The edges of the padded towels were arranged in such a way as to circumscribe the operating field and to leave this alone exposed to the air and to the sight of the operator. Additional padded towels could be used afterward, if necessary, in order to secure a more complete walling-off of the operating field. By means of this procedure the pleural cavity appeared to be almost completely protected against the infection produced by the atmospheric germs as well as against all possible infection or irritation caused by the handling of the serous membrane by the hands of the operators, by the rough sponging with gauze, and by other operative traumatisms. Moreover, when hemorrhage occurred

the blood was prevented from flowing into other parts of the thoracic cavity.

The technique described above was recently used in eight operations of the patching of the pulmonary artery and the incision of the pulmonary orifices; in six operations of cauterization or incision and the suturing of the sigmoid valves and pulmonary orifice, and in one operation of the cauterization of the sigmoid valve of the aorta. In two cases the animal died on the operating table, and in one case in which rubber gloves were not used for the handling of the heart and pericardium, the animal died a few days later of pericarditis. The twelve other animals remained in good health. These results thus demonstrate that in extensive operations on the thoracic cavity, which are often accompanied by hemorrhage from the heart, the pleura can be efficiently protected, and intrathoracic operations may consequently become as safe as operations on the abdominal cavity.

The general principles used in bloodvessel surgery are sufficient for most operations on the heart, and complications such as thrombosis or hemorrhage can be completely prevented by employing a technique more or less similar to that used for the suturing of large bloodvessels. Nevertheless, there is one complication which often causes death in intracardiac operations, and this is the occurrence of air emboli. When the heart is opened wide and closed again by suture it remains filled with air; and when the circulation is reëstablished the blood carries with it a number of air emboli. In operations performed on the right heart or on the pulmonary artery these air emboli did not appear to have any injurious effects; but after the left cavities of the heart or the aorta had been opened and the wall again closed by suture the reëstablishment of the circulation was always accompanied by the entrance of air emboli which were usually most dangerous. A more or less large quantity of air, according to the nature of the operation, entered the mouth of the coronary arteries and produced small air emboli in the terminal branches. They could easily be seen in the lumen of

the vessels and appeared in the form of small air bubbles which filled the ramifications of the arteries. The circulation of the territory invaded by these air emboli was not reëstablished; the muscles remained bluish in color and the heart was unable to recover its normal pulsations. Usually fibrillary contractions occurred a short time after the reëstablishment of the circulation, and this was followed by the death of the animal. The above complications occurred every time that the left ventricle or aorta was widely opened and the air was allowed to penetrate the cavities of the heart. It was evident that some procedure serving to prevent the occurrence of air emboli had to be developed before it would be possible to perform intracardiac operations on the left cavities of the heart. The method selected consisted in aspirating the air contained in the heart after the suture of the wall had been completed and before the forceps used to clamp the pedicle of the heart was removed. The aspiration was effected in two different ways: According to the first procedure a needle was introduced into the left ventricle from where the aspiration was effected. In the second instance a curved-glass cannula was introduced through the line of suture of the aorta as far as the aortic orifice, and the air was aspirated. By using both these methods the heart could be emptied of air, and the production of air emboli after the reëstablishment of the circulation was prevented. As, however, this method of eliminating the air by means of aspiration was often imperfect, a further method had to be discovered whereby the occurrence of air emboli might not only be prevented but also remedied.

In cases where a great deal of air has entered the coronary arteries no treatment at all would be of any use. If most of the branches of the arteries are filled with air bubbles the fibrillary contractions appear almost immediately after the reëstablishment of the circulation, in which case it is probably too late to apply an efficient method of treatment. Nevertheless it is not impossible that even in these cases the recovery of the heart can be effected if the air emboli can be removed. The technique to be described was only used in cases in which small amounts

of air had been injected into the coronary branches. It is well known that the puncture of an arterial wall with a needle, No. 16, is followed by hemorrhage, but that this hemorrhage always stops spontaneously after a short time. By introducing a needle, No. 16, obliquely under the visceral pericardium and by perforating the wall of the coronary artery hemorrhage was produced and the air was eliminated at the same time as the blood. This is but a slight subpericardial hemorrhage which is without danger and is easily arrested. But as soon as the air had been aspirated from the lumen of the artery a normal circulation through the coronary system was reëstablished and the heart immediately resumed its normal pulsations. The prevention of the occurrence of air emboli and their treatment adds greatly to the safety of the operations performed on the cavities of the heart. It eliminates one of the chief causes of fibrillary contraction and subsequent death, following upon intracardiac operations.

It is certain that these new methods of procedure do not suffice to eliminate all danger from intrathoracic operations, but, at all events, they add some important factors of safety to the technique of the operations of the heart and lungs.

OPERATIVE TREATMENT OF AORTIC ANEURYSM

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THE operative treatment of the aorta has until now been limited to the surgical measures which indirectly attack the suffering part.

I draw attention to the operation by Brasdor, the ligature of the subclavia and carotis with their different modifications for the improvement of the thoracic aorta aneurysm, and the lacing round of the abdominal aorta with a thin 2 cm. wide aluminium band by Gatsch, or Halsted's proceedings, who cut strips from a dog's aorta and spirally wound them round that of another dog. Matas and Allen tried to compress the breast aorta of many dogs through pleating the walls, and believed that this successful animal experiment could perhaps be employed with human beings. The introduction of a needle into the aneurysm sac and the slitting of the back wall to produce coagulated matter—after Macewen—the introduction of a long thin wire—after Colt—in the exposed abdominal aorta of Rupert Collins and Braine-Hartnell, etc., are examples of different methods which have been tried in experiments on animals and human beings for the healing of aortic aneurysm; to these methods many more could be added.

Tuffier has operated on four patients for aneurysm of the aorta thoracica, first of all by searching for the beginning of the normal aortalumens at the line of the aneurysm sac, and then pinching and cutting off the same by means of pincers specially constructed for the purpose. This was done by temporarily

resecting the front left wall of the thorax above the second and third sternal costal cartilage, and done by using the overpressure narcosis. This was followed by a double seam after Carrel. One female patient survived for seventeen days, one died owing to secondary hemorrhage caused by infection, again another died through hemorrhage. In the fourth case the operation could not be undertaken.

The direct operative treatment of an aneurysm of the aorta thoracica which was already ruptured, appears to have not yet been undertaken, or anyhow in a very few cases, and it may be of some interest to know something of the method employed therein.

The fifty-two-year-old patient F. was taken into the medical department of our hospital to be treated for aneurysm of the aorta thoracica; two years previously, he had been treated for lues in a New York hospital. He left our hospital of his own free will, to return after a few weeks owing to increased pain, and to the sudden appearance of a tumor on the left side of the back.

The patient, who was a reduced-looking person, complained of intense pain at both sides of the back, extending to the lower extremities, and also of a tumor to the left of the back below, and on the arch of the ribs, which had recently gradually developed. The above-mentioned pulsating tumor which was about as large as two fists, extended from the pelvis of the comb of the spine to above the arch of the ribs. The pulsation, synchronal with the radial pulse, took in the whole tumor which appeared covered only by the skin. The diagnosis of the pierced aneurysm of the aorta was not difficult, the danger, however, that either an interior or exterior rupture would take place, was very great. The radiograph did not show clearly whether the aneurysm was below or above the diaphragm. As the patient grew constantly weaker and as there was great danger that he would bleed to death, we ventured, by an operation, to try to save his life.

Our intention was to expose if possible the aorta either retropleurally or retroperitoneally, after compression to remove the

sac, and to close the opening of the large artery by a seam. For this purpose several ribs (IV, V, VI) directly at the spine were resected, and so large an opening made for the operation in the thoracic wall, that a hand could be conveniently introduced. The pleura, which in the present case was slightly swollen, had not been hurt, so that it was not necessary to bring into use the overpressure apparatus held ready for the purpose. Now the pleura was pushed to the front and the aorta thoracica exposed without trouble. This part (well known to us through the operative exposure of the intrathoracalen esophagus cancer, which we have in several cases made, and I have often wondered how easy it was, in this operation, to loosen the cancerated esophagus), provided that the case was one in which the operation could still be undertaken. The aorta was, without trouble, now exposed as far as the aneurysm sac, and showed itself as lying above the diaphragm. A rubber tube was placed below the aorta thoracica in order to make, if necessary, a temporary closure. We did not bring same into use, but were able to completely carry out compression through finger pressure. When we reached the diaphragm and the upper line of the pulsating tumor which was only covered by a thin skin, the aorta thoracica was digitally compressed between the thumb and forefinger of an assistant, the aneurysm was exposed by a long cut, and the existing slit widened, and a large quantity of clotted blood cleaned out. In order to see clearly the lower part of the normal aorta at the line of the sack, we split the diaphragm slit, and exposed retroperitoneally the upper part of the belly aorta, so that now the aorta thoracica and the abdomen with the aneurysm sack made a clear operation field. The slit in the aneurysm which was larger than a fist, was about 10 cm. long. I now forced my forefinger into the normal lumina of the aorta above and below the aneurysm from the interior of the sac, and cut same in such a manner that a vessel was formed corresponding to the normal aortalumen. The aneurysm, which had chiefly bulged out the back wall of the aorta, hardly touched the part of it behind the spine. The visible opening of the aorta 10 cm. long was now closed by a

continuous seam and the digital compression was slightly relaxed. As some blood still oozed out from various parts of the seam a second continuous seam was placed, without trouble, over the first. During the compression the blood-pressure was doubly increased owing to the elimination of a great part of the circulation. As the digital compression of the aorta, which was necessary for about twelve minutes, was slowly released and completely ceased, the aorta seam proved quite sufficient, as not a drop of blood oozed out of the seam. The pulsation was in both femorals strong and also the pulse in the dorsal arteries was distinctly to be felt. During ten minutes we observed the seam, in the meantime cleaning the wound cavity which was found completely firm and closed. In filling up and removing the wadding from the wound cavity more time than necessary was lost. The wound was then closed. The pulsation in the lower extremities was very good. Through the operation, which lasted about an hour, and also after the completion of same, the feeble patient was in relatively good condition, which may be attributed to the fact that he had been anesthetized by intravenous narcosis and that, through the continuous administration of the common salt and ether, the heart activity was maintained. The patient's strength gradually failed and he died of heart weakness.

According to the experience which I have obtained with successfully executed seams of the aorta and other vessel seams—which I have already reported—the healing tendency is relatively great and technically not so difficult as one generally supposes.

On the microscope slide one saw a large cavity which the aneurysm had formed, and a flat groove which it had dug in the spine. Further, we saw the double (about 10 cm. long) seam of the aorta. If one observes the microscopic slide of the inner side of the cut-out aorta it shows that the seam had nearly restored the normal vessel proportions and that the one outward bulge could have been easily removed by a deep seam, which last may be hardly necessary.

Though this case did not meet with success, as the feeble patient died owing to weakness, it appears to me that for future cases of the operative treatment of the aneurysm of the aorta it is of primary importance and at the same time very instructive. First of all we see that it is possible to expose the aorta retropleurally and retroperitoneally, whereby a great part of the danger of pneumothorax caused by opening the thorax is already removed. Further we see that through digital compression of the aorta the split sac can be removed and that the sac can be nearly normally formed, and by means of a seam safely combined, and that also further measurements could have been undertaken which would have further increased the protection of the seam. I would recommend the covering of the seam with a wide fascies strip and the securing of same to the surface wall with a fine silk thread. In this manner the length of the operation would be only slightly prolonged and the protection of the seam considerably increased.

In similar cases in operating for aortic aneurysm it is to be hoped that we shall have lasting success in the manner that has been indicated.

EXPERIMENTAL OPERATIONS ON THE ORIFICES OF THE HEART

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In the course of experiments made in 1913 and 1914 an attempt was made to develop technique by means of which plastic operations on the pulmonary and the aortic orifices of the heart could be performed. As it is the object of these operations that they be ultimately applied to human surgery, it was primarily necessary to accumulate about the operative procedure a number of factors of safety. It is not sufficient that a plastic operation be possible in order to be practicable. It must also be not dangerous. An attempt was therefore made, not only to perform plastic operations on the orifices of the heart, but to perform these operations without danger to the animal.

The animals were etherized according to the Meltzer-Auer method, and the thoracic cavity was opened under precautions precluding the occurrence of pleurisy. When the operative field had been walled off with silk-and-cotton knotted compresses, the pericardium was opened and the heart exposed. Then, according to the operation to be performed, the circulation of the heart was arrested and the pulmonary or aortic orifices were exposed and opened. In order to ensure the safety of this stage of the operation a number of details of technique had to be observed.

1. The arresting of the circulation of the heart has already been performed in many different ways by various experimenters. We ourselves have used all known methods of stopping the circulation through the heart. Finally we adopted the method of clamping in the mass of the pedicle of the heart by means of a

large soft-jawed forceps. The heart was not taken out of the pericardium, but the incision of the pericardium was large enough to permit of the easy introduction of one of the jaws of the forceps under the pedicle. The forceps was a Doyen forceps, the jaws of which were covered with rubber. One of the jaws was introduced into the pericardium under the pedicle and directed from the right to the left side by the index finger of the operator. Before clamping, the position of the forceps was carefully examined. The handling of the forceps and of the pedicle was always very gentle. Care was taken not to produce any compression of the veins before the time of the clamping. It was important to allow the heart to be in a normal condition before clamping the pedicle. This result was obtained by overventilating the blood, which was easily done on account of the employment of the Meltzer-Auer method. It was noticed that if the heart was clamped before it was in excellent condition the interruption of the circulation could not be as innocuous as when the heart was filled with well-oxygenated blood. The advantage of using the Meltzer-Auer method in this operation is that it permits of an acceleration of the oxygenation of the blood at will. When everything was ready for the performance of the operation the forceps was rapidly clamped and, without a second being wasted, the heart or the vessel was opened and the operation was started.

When the above-mentioned precautions were taken, it was possible to clamp the pedicle of the heart for two minutes and a half or three minutes without any subsequent trouble. As soon as the clamp was removed the heart resumed its pulsation, and after a very short time the pulsations were again normal. In no case was there any need of massaging the heart when the interruption of the circulation did not exceed two and one-half minutes. This probably allows of a considerable margin of safety and it would doubtless be possible to prolong the operation a little without danger to the animals. But two and one-half minutes appears to be sufficient time for the performance of several operations on the valves.

The above technique is apparently somewhat crude, but experience has shown that it was simpler than the separate clamping of the arterial and venous pedicles, and that it required less handling of the heart, which is an important consideration. Moreover the traumatism of the anatomical structure of the pedicle of the heart is slight, on account of the large quantity of tissue which is taken up between the jaws of the forceps and which renders their action less rough.

2. The aortic and pulmonary orifices were exposed by means of incisions made through the anterior wall of the arteries at the level or a little above their junction with the heart. The incision was made with scissors of unequal blades, one of the blades being sharp and longer than the other. This permitted of the perforation of the wall of the artery or heart before cutting. The location of the incision was exactly determined. For the pulmonary artery the incision was made on the left side of the artery at a point corresponding with the junction of the anterior and left sigmoid valves. Several times the valves were exposed by an incision made only on the pulmonary artery. Generally they were exposed by an incision of about 4 cm. made half on the pulmonary artery and half on the ventricle of the heart. In that region the branches of the coronary artery are small and can be cut without danger. The exposure of the aortic valves was made through an incision located on the right side of the aorta between the mouth of the right and the left coronary arteries, generally directly above the middle of the right valve. Great care was taken not to injure the mouth or the branches of the coronary arteries.

3. The opening of the ventricles or of the pulmonary artery and the aorta is always followed by entrance of air into the heart. When the pulmonary artery and the right ventricle were opened, no special care was taken to empty the heart of air at the conclusion of the operation. The quantity of air was probably very small. No accidents have been observed after the entrance of air into the right heart and the lungs. But the introduction of air into the aorta and the left ventricle was

very dangerous. When the operation was completed and the circulation reëstablished the air emboli were sent through the coronary vessels, and this caused fibrillary contractions of the heart and consequent deaths. On several occasions it was possible to see the air emboli in the coronary arteries. It was therefore necessary for the safety of the operation to eliminate the possibility of such a complication. This could be done by aspirating the air contained in the heart by means of a large needle or cannula introduced into the ventricle or into the aorta and connected with a vacuum apparatus. This operation was performed rapidly just before the removal of the clamp and the reëstablishment of the circulation.

Several kinds of operations were performed. The sigmoid valves of the aorta were exposed and cauterized. The pulmonary orifice was cut after the wall had been patched with a piece of vessel preserved in cold storage. These three operations were performed with the purpose of ascertaining whether operations such as should be made in cases of inflammation, stenosis, or dilatation of the orifices would be possible:

1. *Opening of the Aorta and Cauterization of the Sigmoid Valves.* After the artery was exposed and the pedicle clamped the aorta was opened by an incision made with the scissors, just above the sigmoid valves. A large quantity of blood immediately escaped. Next the incision was kept open by two forceps. The blood in the vessel was washed and sponged. The valves could easily be seen and they were cauterized with a thermocautery. The aortic incision was next closed by means of a continuous suture with Chinese silk, No. 1, sterilized in vaselin. Through the line of the suture a curved cannula in communication with a vacuum apparatus was introduced into the aorta and the air contained in the left heart was aspirated. Then the clamp was removed after the circulation had been interrupted for about three minutes. After the occurrence and the treatment of air emboli of the right coronary artery, the heart resumed its normal pulsation, the pericardium was closed, and the operation was completed in the ordinary manner.

2. *Patching of the Pulmonary Artery and Arterial Cone.* This operation was made with the purpose of ascertaining whether the pulmonary orifice could be made larger. The operation consisted in suturing on to the surface of the pulmonary artery a patch of vein preserved in cold storage and in cutting the edge of the orifice underneath the patch. The operation was made in the following way: A piece of vena cava or of any other vein, preserved in cold storage, was cut into the shape of a rectangular flap about 2.5 cm. by 2 cm. This flap was put on the anterior part of the pulmonary artery in such a way that its middle corresponded about to the pulmonary orifice, the lower part being on the surface of the ventricular wall. Then the two lateral sides and the upper sides were fixed to the surface of the heart and the pulmonary artery by means of a continuous suture. The longer blade of the scissors was introduced underneath the lower side of the flap and the point was introduced into the lumen of the pulmonary orifice. Then the wall was cut, and dark blood escaped between the surface of the heart and the lower part of the flap; but the hemorrhage was immediately controlled by the index finger of the operator which compressed the flap down on the wound. The fourth side of the flap was next fixed to the surface of the heart by a continuous suture. The flap immediately appeared distended by dark blood and it was assumed that in case of stenosis of the pulmonary orifice this operation would permit of a dilatation of that orifice. The operation was performed without stopping the circulation of the heart. The operation would be rendered easier by clamping the pedicle of the heart for a very short time. Although this is a more dangerous procedure it is probable that it would simplify the operation.

3. *Suture of the Sigmoid Valves of the Pulmonary Artery.* After the pedicle of the heart was clamped the pulmonary artery and the left ventricle were opened by means of an incision about 4 cm. long. The incisions were located on the left side of the pulmonary artery. Half of the incision was on the artery and half on the ventricle. It passed at about the union of the

left and anterior sigmoid valve. Dark blood was immediately expelled from the heart and after the heart was emptied very little blood remained on the operating field. The edges of the wound were retracted by two forceps. The sigmoid valves could easily be seen and handled with the fingers or with the forceps. In one case the posterior parts of the left and the right sigmoid valves were united by a stitch at about 3 mm. distance from their insertion to the wall. In another case the right sigmoid valve was cut in the middle part with the scissors and the edges of the wound were united by a stitch made with a straight needle, No. 16, and fine silk sterilized in vaselin. When the operation was completed the edges of the incision were united by a continuous suture made with straight needles and Chinese silk, No. 1. Then the clamp was removed and the circulation reëstablished. The duration of the interruption of the circulation was a little more or less than two and one-half minutes. As soon as the clamp was removed and without the necessity of any massage, the heart resumed its pulsations. After a short while the pulsations were normal and the operation could be completed by the suture of the pericardium and the suture of the wall, according to our ordinary methods.

The results of these operations must be considered from two stand-points: (1) the dangers involved to the life of the animal by these operations, and (2) the general and local results of the operations.

When the technique which has been described above is carefully followed out, the operation is of little danger to the life of the animal. In eight cases with the collaboration of Dr. Tuffier we performed the patching and the incision of the pulmonary orifice. One dog died of pericarditis after a few days. This was probably due to the fact that the heart was handled without rubber gloves. Another dog died on the operating table of fibrillary contractions of the heart. This was produced by an error of technique. The flap had been put on the right side of the pulmonary artery instead of the left side, and it was found that some stitches had interrupted the circulation in a comparatively large branch of the coronary artery. In six other

cases the animals sustained no shock. They remained in very good health, and are still normal, six months after the operation. In several of these animals the incision of the orifice was too short. In other cases the flap was too narrow and did not allow for the dilatation of the orifice. The result was that no murmur could be heard by auscultation. Nevertheless, in two cases a marked diastolic murmur was present a few weeks after the operation. It was found that in these dogs the murmur had disappeared after five months. It must be noted also that these remote results demonstrated that a piece of vein put on the pulmonary artery in contact on the one side with dark blood and on the other with the pericardium, that is in an unfavorable condition of nutrition, did not undergo necrosis.

The results of the suture of the sigmoid valves were better. Three operations were performed. Although there was an interruption of the circulation of the heart by the clamping of the pedicle, and the heart and artery were widely opened, the condition of the animals remained perfect, both during the operation and afterward. Not only did these three animals sustain no shock, but their condition at the end of the operation was exactly the same as after the mildest kind of operation. In the afternoon of the day of the operation they were entirely normal again, and today, that is twenty-five days after the operation, they are in excellent condition. The dog on which the section and the suture of the sigmoid valve was performed is an animal about eight years old. Nevertheless his general condition was not modified by the operation.

The purpose of these operations was to show how extensive a plastic operation on the heart can be made without danger to the life of the animal. The results demonstrate that many factors of safety have been placed in the technique. It will perhaps be possible to perform successfully more complicated operations than those we have described. These results are being published at the present time merely to show that plastic operations on the heart need not be dangerous. It is not impossible that some day surgeons will be able to cauterize valvular lesions or to repair them as we do today in our experimental operations.

DISTANT RESULTS OF A SUTURE OF THE HEART FOLLOWING A WOUND BY PISTOL-SHOT

By ROBERT PROUST, M.D.
PARIS, FRANCE

Four years ago I operated on a youth, fifteen years of age, for a wound of the heart.

He was able, after being cured, to return to his normal mode of living. Since the operation I have never lost sight of him, as he comes to see me regularly.

Lately, more than four years after the intervention, I have been able to examine with details, thanks to radioscopy, radiography and electrodiagnosis, the working of his heart. These are the results I shall have the honor to examine before you; but before doing so, I think it right to give you the details of this observation:

On February 20, 1910, being on duty, I was called at 5 o'clock in the afternoon for urgent service at the Trousseau Hospital, in Dr. Savariaud's ward, for a wound in the heart; diagnosis made by Messrs Bloch and de Cumont, internes of the service.

On arriving, I saw a boy, thirteen years old, very tall for his age, who had been shot in the precordial region. His condition was as follows:

At the beginning of the afternoon (at 10 minutes past 12 exactly), one of his little playmates had inadvertently pressed the trigger of a loaded pistol with which he was playing, and which fired at a distance less than one meter.

The blackish orifice, where the ball entered, is easily seen inside the nipple, and a rather wide streamlet of blood flows con-

tinuously from it. On auscultating, the beating of the heart is muffled but perceptible, the cardiac dulness seems to be enlarged at its basis. There is no sign of hemothorax. Traube's semilunar space is sonorous.

The pulse indicates about 100, but has a very bad tone, very unsteady in strength and rather undulating. The patient is extremely pale, in spite of numerous injections of serum and camphorated oil, of which the first were made by Dr. Gagnière, and which had pulled him through the great shock he had at the beginning; he is quite conscious, but is in great distress, a very acute dyspnea, and intense thirst and very great pain in what he called "the region of the heart." His physiognomy is imprinted with a striking anxiety. There are evidently symptoms which plead strongly in favor of a heart wound, especially the state of the pulse, but for once in a way it might be a question of simple shock. So, while everything is being prepared for the operation, I remain near the patient in order to closely appreciate the movements these divers symptoms are about to make.

After a rather long period of hesitation I have the impression of a progressive aggravation and decide on operation.

From the beginning I ascertain as far as possible the traject of the ball. For this, after having traced a cutaneous incision according to Fontan's rule, I lift the skin and soft parts along the border of the sternum, and find the fifth costal cartilage shattered by the ball; I raise it and come across a mass of liquid blood, which bubbles and is animated by beating; I then quickly complete the flap by sectioning the fourth and sixth costal cartilages at their sternal insertion. The turning down outward of the flap simply by elasticity is quite easy since it is a question of a thirteen-year-old boy. I am very careful in this turning down to unfasten and push back the pleura; it was wounded by the shot at the level of the precordial part and the passage of the air is heard at each respiration, I cover with compresses this breach, of which the walls are too infiltrated with blood to allow of suturing.

Ligature of the two ends of the internal mammary and the

sectioned intercostals. I then cleanse the operative field, and after having sponged much blood and tamponed the lower part of the wound (where the blood comes from) I clearly see the forepart of the pericardium, and by transparence above it, the forepart of the heart which slides at each beating, but seems to be separated by a thin liquid sheet. I then take away the compress which tents the lower part of the wound, that is to say, the lower part of the pericardium. A spirt of blood is produced immediately and I clearly distinguish the wound in the pericardium from which it comes. I enlarge this wound with my scissors, both from the top and the bottom, to an extent of about 8 centimeters or about 3 inches, and mark the borders of the serous membranes with forceps after having isolated the operative field.

I am thus easily able to explore the pericardiac cavity, but at the level of the base I see only blood, and cannot distinguish the point of the heart. This is caused by the fact that all the base of the pericardium is filled with a *coagulum as large as the fist, which covers the point of the heart and compresses the heart upwards.*

I extract the coagulum, and with it the ball, which was free in the pericardium. As soon as the coagulum is taken away the point of the heart appears freely with its pinkish-white color; there is clearly distinguished a wound in the front residing near the left border quite near the point; a jet of blood escapes from it at each systole. Moreover, from the moment the coagulum is taken away, the heart begins to beat in a most immoderate manner, and it is with great difficulty that it is grasped. I am moreover troubled by the stock of instruments, for, at the beginning, I have at my disposal only a curved Reverdin's needle of the current model. It is with this that I quickly make my first stitch which perforated totally the wall of the heart; once knotted it stops the hemorrhage a little, but blood escapes along the thread. From this first stitch I am able to make three others, non-perforating, by using this time the small Reverdin's intestine needle. I hide the first set

of transversal sutures by a second plane of superficial sutures. I then turn the heart upward to look for a second wound on the posterior face but I find none. But seeing the descendent obliquity of the traject of the ball, I come to the conclusion that it is a tangential wound, although a penetrating one.

Suture of the pericardium with separated stitches of catgut No. 0; the lowest stitch fixes a very small rubber drain, which is level with the serous membrane and even penetrates into it at a little less than a centimeter; the drain has a vertical traject and comes out again in the lower horizontal branch of the cutaneous incision near the sternum. This drain was used on account of the relatively long time between the accident and the operation, and also on account of the finding of the bullet in the pericardium.

The flap is turned back (without suture of the pleura, which I find too infiltrated), and as I fear the edge of the lowest rib might wedge the drain, I protect the latter with a little tent of about 3 centimeters long, not going so far as the pericardium.

Reunion of the muscular surface with catgut. Fishgut for the skin. Subcutaneous serum during the whole of the operation.

Operative Consequences.—Immediately after the operation the patient is taken back to his bed, in appearance hardly the worse for the operation.

The next day, February 21, there is a considerable thermic reaction. In the morning 39.8° C., that is about 103.6° F., and in the evening 40.4° C., or about 104.8° F.

In spite of this the general status is not alarming, the pulse indicates 110.

The following days there is a slight fall in the temperature which, however, remains very high.

On the ninth day, ablation of the small tent joined to the drain; immediately after this follows the escape of a reddish serosity, non-purulent, and of which the rhythmical flowing is isochronal to the cardiac beating (at this moment the temperature is about 102°, but the general status, which remains good, continues to disagree with this temperature).

Pulse indicates 96.

March 2 and 3. Same status.

March 4. The oozing tinged with blood which followed the ablation of the tent has stopped, the patient has a little chill, and in the evening the temperature is 104°.

March 5. Messrs. Proust and Perinaud examine the patient in the evening; the pulse is very undulating, of very feeble tone and indicates 120. The heart-beats are exceedingly dull on auscultating, the patient has some trouble in swallowing, which has increased since the operation. Briefly, there are evident signs of pericardiac effusion. The small rubber drain, however, produces nothing. It is still solidly fixed in the depth and oscillates with the cardiac movements; I pull it away with a sharp tug and immediately out flows a great abundance of blood-stained serosity which is in no way purulent. The hand which palpates the radial pulse feels that little by little it puts itself right from this moment. It becomes pronounced, excellent, very strong.

From this moment the effervescence begins to cease, and finishes in less then forty-eight hours. The patient leaves the hospital on March 21, 1910, cured, one month after the operation.

Examination on leaving the hospital: Temperature normal, pulse 80, the beating of the heart seems normal, the troubles of swallowing have totally disappeared as well as the rising of the stomach which attended them.

The patient was presented at the Société de Chirurgie at Paris on April 13.

Immediately after his departure from the hospital, on March 21, 1910, he was engaged as telegraph messenger at the Post Office in Paris, and able to return to his normal mode of living.

He followed this calling of telegraph messenger during three years, and in spite of the fatigue experienced in climbing long staircases, he did not show any functional cardiac troubles; at the most he did notice, in the beginning, a little panting after hurrying upstairs. Since a year ago he has changed his profession. He is now a bookkeeper and complains of no trouble

whatever. Having his address I asked him if he would be examined in order to see if, a long time after the operation, our means of investigation would show, in spite of the total absence of functional disorders, anything abnormal, either at the level of the cardiac suture properly speaking, or as remains of the pericarditis he had shown.

With this aim I asked my colleague and friend Dr. Bezaçon, chief physician at the Charity Hospital, to be good enough to consult him; Dr. Aubourg, chief of the Radiology Service at the Coucicault Hospital, to kindly radiograph him; Dr. Bour-

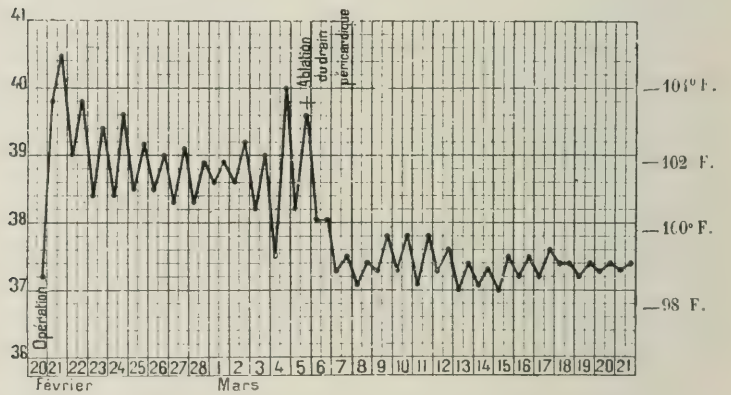


FIG. 1.—Graphic.

guignon, chief of the Laboratory of Electricity at the Salpétrière Hospital, to be kind enough to trace out his pulse, and Dr. Boulle, chief at the Marey Institute, to be kind enough to take his electrocardiogram.

The auscultation and electrocardiogram have established that the working of the heart was almost normal. But the point of the heart seems a little too near the sternum and the electrocardiogram shows a double bracket at the time of the ventricular contraction. The radioscopic examination has shown us very slight modifications consecutive to the sutures.

Here are the notes kindly provided me by Dr. Aubourg:

Radiologic Examination. The examination of the frontal region of the heart shows:

The left auricle has a normal aspect and volume.

The right ventricle has also a normal aspect.

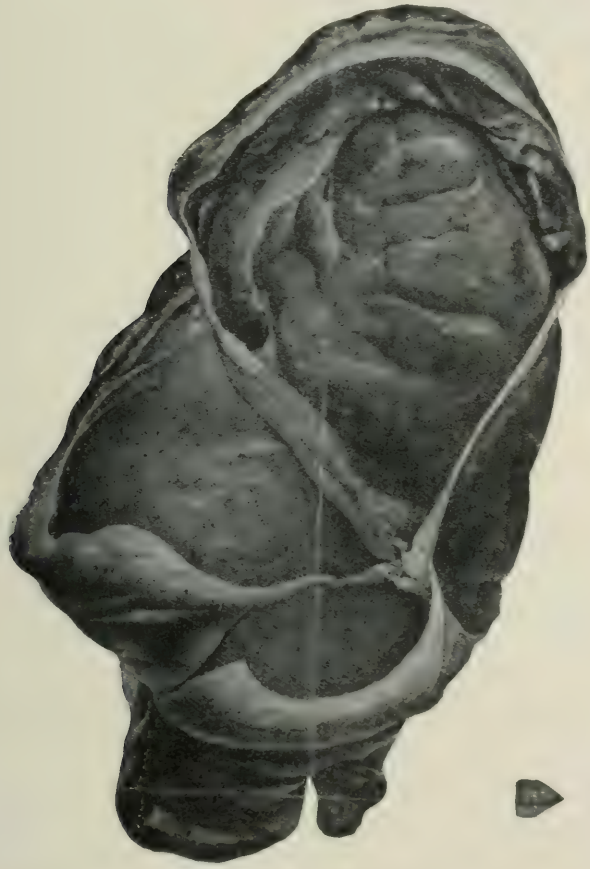


Fig. 2.—Intrapericardiac clot and bullet extracted from the pericardium.

The part of the left ventricle which forms the left border of the heart presents a normal shape; at the union of the external $\frac{2}{3}$ and the internal $\frac{1}{3}$ of the left border at the height of the fifth rib, is seen a permanent notch, which seems to be a fixed point

which does not participate in the beating of the left border, as if at this level there were something which restrains the left border, such as retracted adherence. Moreover, below this

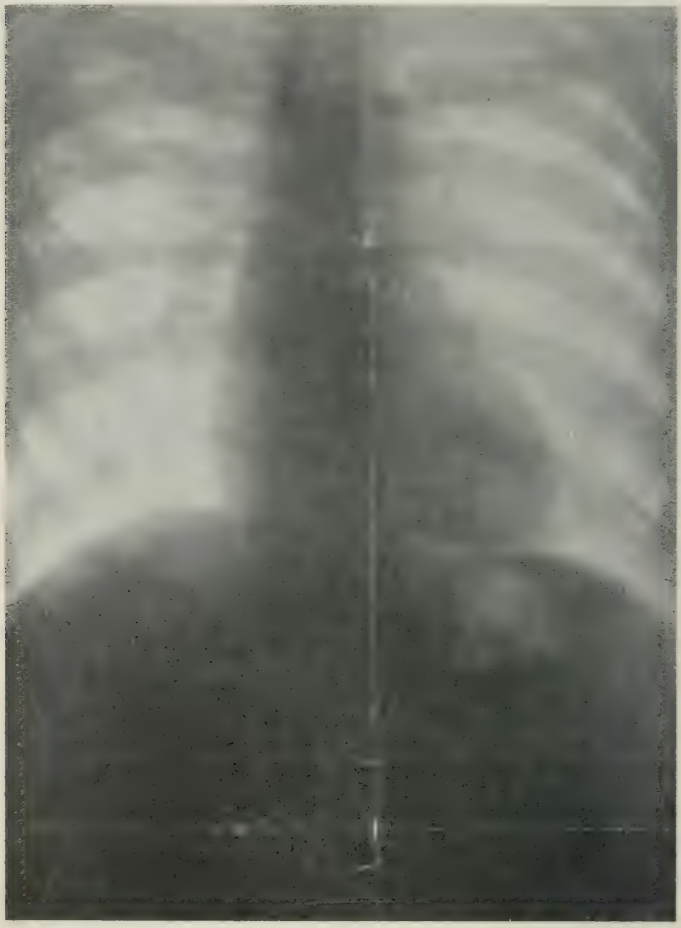


FIG. 3.—Radiograph.

notch, is seen, on the left ventricle itself, a circular zone of $\frac{3}{4}$ inch diameter, and which, by its clearness, shows up on the deep color of the remainder of the ventricle.

Afterward, on practising divers oblique examinations, in order to judge the status of the left auricle and the posterior part of the left ventricle, it is seen that these cavities are neither deformed nor dilated.

The nature of the mark seen on the forepart is interesting to note; this might be an adherence of the pericardium, but one would not understand why the subjacent myocardium should not have preserved its thickness; so I believe it is question of an abnormally thin state of the myocardium following a scar, for example.

The second part of the examination bears on the esophagus; the patient is placed in an oblique position, in order to distinctly see the clear space which exists between the vertebral column, the aorta, and the heart.

The patient has absorbed milk of carbonate of bismuth; the bismuth has designed an esophageal duct of normal aspect as far as the origin of the large vessels. From this place, as far as the diaphragm, that is to say, over nearly four inches, we have seen a diminution of size of the duct, which can be estimated at a half of the normal caliber. When the bismuth got to the cardia we ascertained antiperistaltic movements several times and these movements are caused by a parietal lesion of the esophagus. These are two objections against the supposition of a lesion of the internal tunic; first, the absence of dilatation above the stricture; second, the regularity in the diminishing of light, whereas in the lesions of the internal tunic there exists an essentially irregular canal. We may, therefore, think that it is question of lesions of the external tunic, perhaps by adherences to the pericardiac pouch in relation with the auricles.

What does this examination prove?

That there incontestably remains some esophageal troubles connected with pericarditis and that, on the other hand, there persists either a slight weakening of the cardiac wall at the level of the scar, or perhaps a pericardial adherence at this level.

These declarations obtain their value from the agreement

of the two phenomena observed by Dr. Aubourg: first, the esophageal troubles and the cardiac zone being lighter and more immovable, corresponding to the troubles of swallowing that the patient had experienced after the operation; second, to the precise passage of the bullet which had shattered the fifth costal cartilage.

The radioscopic ascertainings have indeed been established by Drs. Aubourg and Lebon, who were absolutely ignorant of the exact level of the wound in the heart and the troubles in swallowing that the patient had experienced after the operation.

Pericarditis continues to be the great obstacle to the perfect cure of wounds of the heart. In this particular case I willingly attribute its origin to the sojourn in the pericardium during a prolonged time before the operation, of the bullet, which, it appears, not having a very considerable speed, might easily have got contaminated from the contact of the clothes or dragged a particle of dirt with it. It was, in any case, a very attenuated pericarditis, because the serosity was in no way purulent and the simple evacuation brought about the cure.

Although not a partisan of drainage in heart wounds, I believe that in this particular case, the fixing of a small rubber drain in the very orifice of the pericardium enabled us, if not by its presence, since it disappeared immediately, at any rate by its ablation, to obtain the result which would not have been obtained without it, except by a paracentesis of the pericardium. I believe there would be great interest in submitting to radioscopic and radiographic examinations patients who have been operated on for heart wounds, and by such, we shall get to know in precise manner the exact value of distant results.

BULLET IN THE PERICARDIUM; AURICULAR FIBRILLATION

By GEORGE E. ARMSTRONG, M.D.
MONTREAL

There was admitted to the Royal Victoria Hospital, Montreal, on February 17, 1913, an Italian, aged forty-six years, complaining of a wound in his chest.

He says that he was treated for pneumonia in this hospital nine years ago. He has taken alcohol very freely.

He stated that at 5 A.M. on the day of admission he was shot by his son. The assailant used a .32 calibre revolver and stood in front of him and about five feet away. The patient says that he was dazed for a moment and then recovered and pursued his assailant, but was unable to run far on account of weakness.

He is a well-developed, well-nourished Italian. He can assume any position; complains of but little pain. There is no respiratory distress. His general condition is good. Pulse regular and not rapid. There is a small punctured wound opposite to the third intercostal space and slightly to the left of the border of the sternum. There is no staining or charring of the skin and but little tenderness on pressure. There is no discharge from the wound and very little discomfort on taking a full breath.

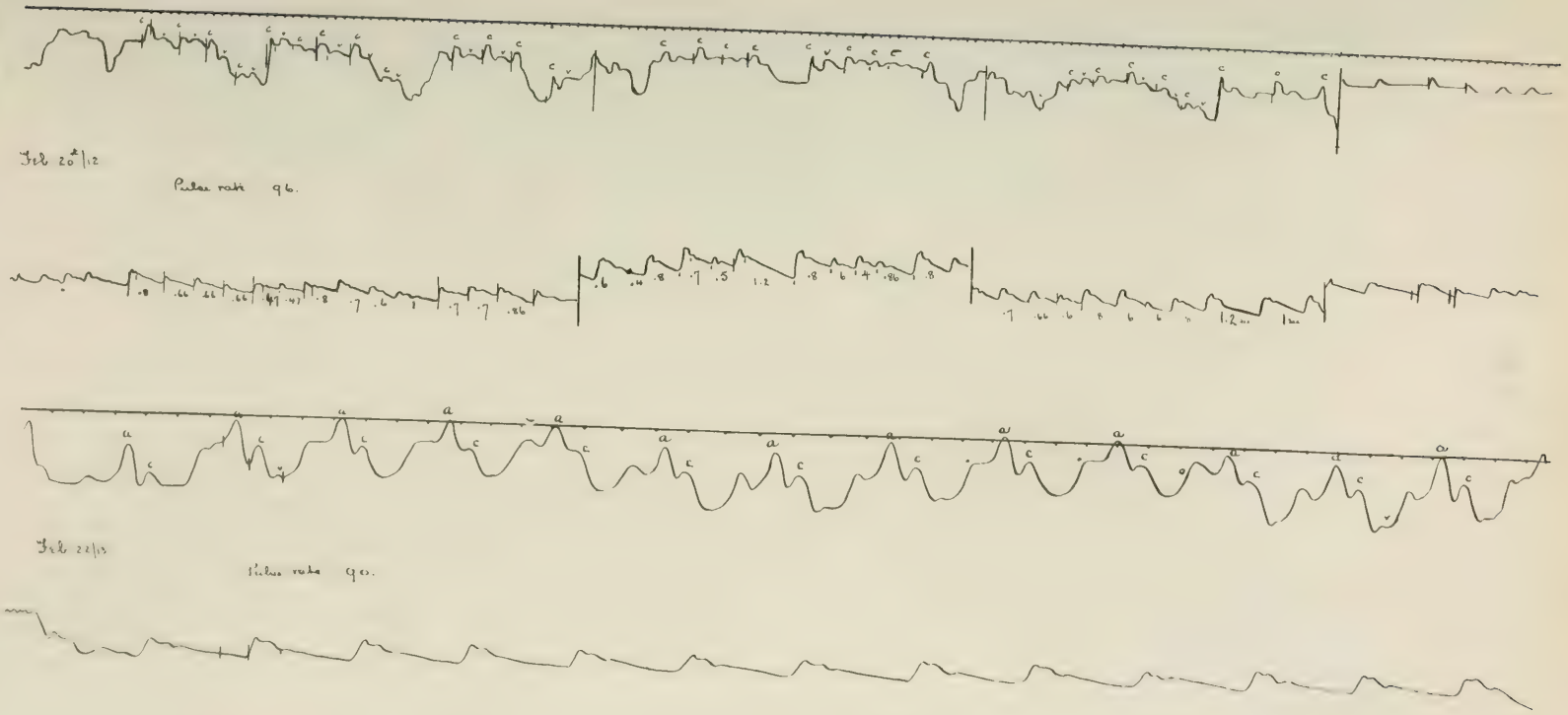
The chest is emphysematous, but there is no evidence of pneumothorax or of air or blood in the pericardium. No murmurs can be heard nor any friction rub. An examination of the abdomen was negative. In the afternoon the pulse became irregular, missing every fourth to tenth beat.

A fluoroscopic examination of the chest showed the bullet lying loose in the pericardium, moving with each heart beat, and changing its position with the changing position of the patient. If the man lay on his right side the bullet rolled to the right, and back again to the left when the man rolled on his left side. The bullet seemed to lie most naturally toward the right. Marked irregularity in the pulse developed when the patient was moved frequently from one side to the other. In the late afternoon a slight cough developed.

During the succeeding four or five days, the only changes to be noted were increasing irregularity of the pulse and a change in his general condition. It was evident to everyone that the man was losing ground. The temperature elevation was not great, a hundred and two-fifths was the highest. The change in the pulse was definite. It became more rapid, more irregular, and smaller and more compressible. Two physicians, Drs. Martin and Hamilton, saw him with me daily and the different views soon took definite form and largely on one issue. None of us had had any experience in similar cases to guide us. The important question at the moment was, Should the bullet be removed or not? The physicians inclined to the view that the bullet had done its work. That there was, very likely, an injury to the heart, either to the auricle or to the ventricle or the auriculoventricular groove, but that the bullet now lay free in the pericardium and that it was a matter of no importance whatever to the patient whether the bullet was removed or not. Against this theory was the daily, progressive, general failure in condition and the increased rapidity and irregularity of the heart's action. The proposal to remove the bullet was finally assented to on the ground that he would be no worse afterward and might be better. A tracing showed complete auricular fibrillation.

A radial tracing showed an irregularity both in volume and rhythm; the figures under each pulse period indicate the duration in seconds. Line marker in 1.2 seconds.

On comparing the radial with the venous tracing it can be seen that the irregularity is not due to extrasystoles. There


Feb 20th/12
Pulse rate 96.
Feb 22/12
Pulse rate 90.

was a marked and rapidly irregular pulsation of jugular veins in the neck. The venous tracing is of the so-called ventricular type, showing the same irregularity as shown in the radial with an utter absence of any wave due to auricular contraction. The carotid and "V" waves are the only waves represented.

This combination of an absolute irregularity and absence of any sign of a regular and definite auricular contraction can be due to only one condition, viz., auricular fibrillation.

In the afternoon of the fifth day I removed the bullet. Ether was administered by the intratracheal insufflation method.

Wilm's intercostal incision through the fourth intercostal space brought me readily down upon the pericardium. The internal mammary artery was divided between two ligatures. The pleura was opened and the lung allowed to collapse moderately. A rib-spreader was inserted and the pericardium opened. I now passed my finger within the pericardium but could not feel the bullet, although the patient was rolled from one side to the other. A portion of the fifth rib was resected and I could then pass two fingers in and feel the bullet lying directly behind the heart. By rolling the patient well over on his left side the bullet came within reach of my fingers and was hooked out. There was little blood or effusion in the pericardial sac.

The opening in the pericardium was then closed with catgut sutures without drainage. A little increase of pressure in the intratracheal apparatus brought the lung out to the level of the incision in the chest wall, which was then closed, leaving very little if any air in the pleural cavity.

Throughout the operation for the removal of the bullet the pulse retained the same characteristics and a rate of 130 to 140, varying slightly throughout the anesthesia. After the bullet was removed and before the pericardium was sutured the pulse obviously quieted and the rate was 120 at the carotid. Two and a half hours after the operation the pulse was 105 and perfectly regular. A tracing taken the next or following morning showed what to all intents and purposes was a normal tracing, a well-marked and large auricular wave and a large onflow wave. The

radial tracing was regular in volume and rhythm and showed a rate of ninety per minute.

Conclusions. 1. Onset of auricular fibrillation in a heart where, as far as could be ascertained, there had been no previous inflammatory mischief, no symptoms of any cardiac involvement, due to the presence of a foreign body.

2. Cessation of the disorderly rhythm on the removal of the cause—the bullet.

3. A rare opportunity of observing the heart in such a rhythm.

We have been unable to find any reference in literature to a similar condition.

DISCUSSION ON THE PAPERS OF DRS. HAMANN, KÜMMELL, CARREL, PROUST, AND ARMSTRONG

Dr. Francis T. Stewart, Philadelphia.

First I wish to mention in connection with Dr. Kümmell's paper a case of aortorrhaphy. The patient was suffering from vegetative endocarditis and had an embolus lodged at the bifurcation of the abdominal aorta. There was beginning gangrene of the right leg and prodromal symptoms of gangrene in the left leg. The abdomen was opened, the posterior parietal peritoneum split; the aorta compressed between the fingers of an assistant, the aorta incised, and the embolus dislodged without difficulty. This operation was done several days after the impaction of the embolus, and aside from the successful suturing of the vessel is of importance in showing that the embolus was not adherent. As soon as the artery was opened, with a little compression the embolus slid out of the aorta without difficulty, and the pulse was reëstablished in the lower extremities. The patient unfortunately died four days after operation, not, however, from bleeding. The sutures held and the patient died from edema of the lungs as a consequence of the cardiac condition.

I should also like to mention in connection with Dr. Armstrong's paper a patient with a bullet lodged in the fat about the base of the aorta within the pericardium. I operated with the idea that there was a heart wound and found the pericardium moderately filled with fluid, removed the bullet, did not drain the pericardium, and the patient recovered.

In connection with Professor Proust's paper, at the last meeting of the American Surgical Association, I reported five cases of suture of the heart. Three recovered, and at that time I said that those who were still living showed no evidence of cardiac degeneration. These

patients have not been examined as carefully, I must admit, as Dr. Proust's patients. *X*-ray pictures have not been made, nor has the electrocardiogram been put into use. One patient, who was seemingly well so far as the heart was concerned for five years, died at the end of that time and autopsy showed what Prof. Proust pointed out ought to occur, *i. e.*, pericardial adhesions. In that patient the descending branch of the left coronary artery had been tied at the operation, and in the areas supplied by this artery there was a marked interstitial myocarditis, with thinning and dilatation, not so great, however, as to justify the diagnosis of aneurysm.

Dr. Willy Meyer, New York.

In discussing such a subject we must not forget that we are just on the threshold of thoracic surgery, but the papers presented are of deep interest, and certainly will induce us to proceed further on the way we have tried so far. Personally I would say that so far we did not take such great precautions to protect the pleura; we try to proceed in thoracic surgery as in abdominal surgery, and to close the thorax where everything is done aseptically. As soon as it comes to the point where we cannot control asepsis and we expect pleuritic effusion, then, I believe, drainage of the thoracic cavity is indicated. The method of not opening the pleura in operations for esophageal carcinoma, proposed by Dr. Rehn, Jr., and in Trendelenburg's operation for pulmonary embolism, mentioned by Professor Rehn, and the interesting attempt of Prof. Kuemmell of extirpating an aneurysm of the thoracic aorta by entering the posterior mediastinum, without opening the pleura, will induce many to try this route in similar cases. Regarding Trendelenburg's operation, I believe that the transpleural route under differential pressure will become the method of choice. With the help of Professor Rehn's "Handgriff," brief compression of the superior and inferior venæ cavæ, we surely will make progress and possibly soon save a life.

Regarding the aneurysm of the aorta: At the present time we must deal with present conditions. It is due to Dr. Wm. C. Lusk, of New York, who has persistently followed up the method of introducing a special wire into the aneurysm and treating it then with electrolysis, that we may hope to improve the condition of these patients. We have seen patients presented by him who went back to work, for instance, as stone-cutters. absolutely hopeless cases, where the method has brought a wonderful improvement. Personally, I had an absolutely hopeless case of aneurysm of the ascending aorta, a man, who had been in bed over five months, on account of debility, expectorating blood, etc., thought to be due to tuberculosis. The sac was treated according to Lusk's method. The man greatly improved and lived eleven months as he was continuously opposed to

after-treatment with salvarsan, nothing was done along this line. The patient certainly was ever so much better; formerly bed-ridden, he could climb four to five flights of stairs and walk many blocks; the expectoration of blood ceased entirely. Death occurred suddenly, evidently from bursting of the sac; autopsy could not be obtained.

What we must try at present, after the wiring, is to keep the patient alive. Whether this can be done by repeated small doses of salvarsan or otherwise, the future will show. At the present time in cases of aneurysm, attached to the thoracic wall, where the cavity can be reached safely by the wire and electrolysis, I believe this to be the best method. But that does not mean we have reached the goal; all experiments should be vigorously continued. The future will then show more radical methods and more lasting results.

Dr. Howard Lilienthal, New York.

Certain operations upon the mediastinum may be followed by auricular fibrillation. I have noted this phenomenon in a case of mediastinal tumor in which the growth was removed by splitting the sternum according to the method suggested by Milton and Sauerbruch. This case with the tracings will soon be published. The colleague who made the tracings for me, Dr. B. S. Oppenheimer of New York, stated that there was no known case in which the phenomenon had been actually observed upon the heart itself inthe human subject. Dr. Armstrong is, therefore, probably right in assuming that he is the first surgeon who has actually seen the human heart in a state of fibrillation of the auricles.

Professor Charles Henschen, Zurich (by invitation).

For about two and a half years I have occupied myself experimentally with the problem of the surgical treatment of aortic aneurysms. For saccular aneurysms of the thoracic aorta in which Tuffier advocated the simple occlusion ligature, comes forward for discussion the analogous operation of Matas. In regard to fusiform aneurysms of the thoracic aorta, the principle of strengthening by operation the diseased wall of the vessel has been viewed from the aspect of its practicability. I have attempted, experimentally, such a strengthening of the vessel wall in two ways. In one of these the aorta, in segments, is strengthened from without by broad bands consisting of flaps of fascia sewed around it. The results of my attempts extending over more than two and a half years, and corresponding with similar attempts on the part of Krischner and Halsted, go to show that these cuffs of fascia make possible an easily healing, mechanically excellent and safe reinforcement of the vessel wall.

The second method is that by which tubes of absorbable material (of galatholith) of a calibre corresponding to that of the aorta, and

in any case corresponding to the lumen below the damaged area of the vessel, are inserted through a longitudinal cut in the wall of the aorta into the lumen extending through the whole aneurysmal portion. The blood through the diseased portion of the aorta now flows through these inserted tubes, and in these oval openings may be made to correspond to the origin of the larger and more important vessels in order to permit of the free passage of blood. At the lower end of the galatholith tube is bored a circle of round holes which permit the fixation of the tube by means of interrupted sutures penetrating through the wall of the aorta. Perhaps a combination, though this is still to be noted as experimental, of the outer fascial wall reinforcement and the tube method is more to the purpose. The experiments with the tube method are still under way.

Dr. Harvey Cushing, Boston.

I presume that it is true that the surgery of every organ has begun as the surgery of its traumatic lesions, and it seems to me that the more interesting part of this discussion concerns the treatment of pathological rather than traumatic lesions of the heart. The brilliant results such as have been given to us by Dr. Armstrong, Professor Proust, Dr. Stewart and others have shown what we may expect in the case of traumatic lesions. What can we do, what can we look forward to, in the line of Dr. Carrel's exceedingly interesting paper? I believe Sir Lauder Brunton was the first to suggest that we may be able to operate for lesions of the cardiac valves, particularly in cases of stenosis.

Some years ago in Baltimore a long series of experiments were undertaken in this direction, but our operations upon the cardiac valves were performed in a very much more crude manner than with the methods employed by Dr. Carrel. The lesions were made by introducing into the heart, either into the apex or into the larger vessels, knife hooks by which we could divide the valves, and it is extraordinary how simple these measures actually are. The character of the lesion was determined by the application over the heart of a phenendoscope so that one could tell by the murmur when the lesion which was desired was brought about. These experiments were chiefly useful at the time as serving as subjects for the physical diagnosis class in cardiac studies, for they furnished us with known cardiac lesions for the students to listen to. We were only able to reproduce the insufficiencies of the four valves with any satisfaction; the experimental stenoses were much more difficult. With Dr. Carrel's methods I doubt not that stenosis by suturing of the valves directly under the eye can be produced.

We have always hoped that a suitable opportunity might arise

by which even with our crude methods it would be possible to transfer a stenosis into an insufficiency, for a severe mitral stenosis is unquestionably the more serious lesion. Recently in the Brigham Hospital a patient who had been in and out of the medical wards with a severe mitral insufficiency finally came in with a complete decompensation, and while in the ward had a sudden embolism of the right femoral artery, lodging just at the bifurcation of the profunda femoris, and had my colleagues had as much respect for my ability as had Dr. Stewart's for his, we would doubtless have been called upon to remove this embolus. This man had a dry gangrene of the lower extremity up to the knee. Amputation was performed and not long after the operation he succumbed to his cardiac lesion. At the autopsy nothing was found in the heart except the familiar button-like slit of the mitral valve. If without undue risk one could only have inserted the knife hook into the apex of the heart and have transferred his stenosis into an insufficiency his symptoms might have been greatly alleviated.

Although it is possible to operate upon the normal heart (and it is extraordinary how the normal heart tolerates even more serious manipulations than those reported here today), does Dr. Carrel feel that when cardiac disease is present we may hope to be able to clamp the root of the heart and to carry out some of these more serious operations?

Dr. Francis T. Stewart, Philadelphia (in closing).

It occurs to me in connection with Dr. Carrel's work that it might be possible, although this is conceived just at this moment, to increase the orifice of the heart somewhat in the same way that the orifice of the pylorus or the orifice of the ileocecal valve is increased, as suggested by Dr. Martin, by an incision down to the endocardium but not into it, allowing the wound to spread and then suturing it in another direction. Or if it is desirable to decrease the opening a portion might be excised without cutting into the heart cavity itself, and the wound sutured.

Dr. Alexis Carrel, New York (in closing).

With regard to Dr. Cushing's question of the possibility of performing extensive operations on a diseased heart, I can only say that it can be solved only by experience. It is sure that if the muscle itself is diseased we cannot make any operation which involves the clamping of the pedicle of the heart and the stopping of the circulation.

As regards Dr. Stewart's suggestion of making a plastic operation in stenosis and suturing in the opposite way, I do not believe it is possible, because the tissues are so taut that we could not bring them together without rupture.

THE CHOICE OF ANESTHETIC IN OPERATING FOR ABSCESS OF THE LUNG

REPORT OF TWO CASES OPERATED UPON UNDER LOCAL ANESTHESIA

By FRED T. MURPHY, M.D.
ST. LOUIS, MO.

Operations in the intrathoracic cavity have been possible under physiological conditions only since the introduction of the negative and positive pressure methods of Sauerbruch,[1] and Brauer and Peterson,[2] in 1904, and the intratracheal insufflation method of Meltzer and Auer[3] in 1909.

That remarkable progress has been and will be made in the surgical treatment of intrathoracic lesions, and that the advances will be dependent upon the proper use of some one of these methods, no one can question, but a sharp distinction should be made between intrathoracic operations in which the free pleural cavity will or may be opened and operations in which the pleural cavity will not be opened. Judged from the case reports and the general discussions regarding intrathoracic operations, it does not seem to me that this distinction has been sharply made.

Success in the surgical treatment of non-tuberculous abscess of the lungs depends mainly upon four factors; the correct diagnosis, interference before the patient is so toxic as to be beyond relief, drainage without infection of the free pleural cavity, and avoidance of any factors which may tend to cause an extension of the infection to uninvolved portions of the lungs.

A careful physical examination, together with the use of the stereoscopic *x*-ray plates, should lead to as definite a localization of the abscess cavity, except in most atypical cases, as is possible after intrapleural exploration of the lung.

The result in cases operated upon as compared with those treated expectantly must more and more influence the time of operative interference. These results show that abscess of the lung untreated gives an 80 per cent. mortality as compared with a mortality of 17.5 per cent.[4] with operation.

Drainage without infection of the general pleural cavity can be accomplished with certainty only when instituted through adhesions between the parietal and visceral pleura. Nature herself provides these adhesions in approximately 50 per cent. of the cases. In cases where such adhesions do not exist, they may be caused by a two-stage operation. The essential factors of this two-stage operation are that at the first stage an ample flap of the chest wall, including the skin, subcutaneous tissues, and muscles, shall be turned back. The ribs are then resected subperiosteally, and the intercostal vessels ligated. Finally the lung is sutured to the parietal pleura around the edges of the area thus exposed, or adhesions may be caused by packing gauze over the surface of the parietal pleura. At the second stage, the skin-muscle flap is again turned back and the abscess opened through the firm adhesions.

If a general anesthetic is used with any one of the three methods before mentioned, the lung may be distended while these fixation sutures are being placed. If a local anesthetic is used, the patient can readily expand the lung at the desired time. Of the general anesthetics, chloroform, ether, nitrous oxide with oxygen have been successfully used. In the light of clinical experience, however, and with the knowledge of the immediate or late effects of chloroform as shown by the experience of Opie[5] and others, we can no longer, I think, justify the use of chloroform as a general anesthetic. The use of ether as routine is probably attended with less danger than that of any other general anesthetic, but ether has

a specifically irritating action upon the respiratory tract. Theoretically, therefore, ether is not an ideal anesthetic for these cases, though it must be acknowledged that because of the greater familiarity in administering ether, it can probably be used with greater safety in most clinics than nitrous oxide. Nitrous oxide with oxygen would seem to be the ideal general anesthetic for these cases of lung infection. The mixture itself is not irritating to the respiratory tract. The anesthesia may be carried out to the satisfaction of the operator, and yet be of so light a degree that the protective reflexes of the trachea are only temporarily abolished. The depressing effect is less marked than with any other general anesthetic. Any general anesthetic increases the danger of pulmonary infection, and should be used only in cases in which, on account of the failure to localize the cavity, preliminary exploration of the lung is necessary, or in children who cannot be controlled with a local anesthetic.

Theoretically, any one of the three methods mentioned for the prevention of the collapse of the lung with the pleural cavity opened may be used. Practically, the intratracheal insufflation method is distinctly superior to the positive and negative pressure methods, because it possesses all the advantages of either and eliminates many of their disadvantages. Further, by the force of the return current of air along the intratracheal tube, the accumulation of foreign material in the trachea is prevented, thereby lessening the danger of further infection in the lung.

With the exceptions noted as applying to abscesses which are impossible of sufficiently definite localization, and in children, local anesthesia, with or without morphia or scopolamin, with some one of the less toxic drugs such as stovaine or novocaine, avoids entirely the dangers of any one of the general anesthetics. The reflection of the flap and the resection of the ribs can be accomplished without pain and without increasing the difficulties of the operator. In the second stage of the operation, only limited infiltration of the local area through

which drainage is to be instituted is necessary; in fact, the opening of the cavity may be accomplished with no anesthetic other than morphia or scopolamin.

The two cases which I have to report are as follows. They are both from the surgical service of the Washington University Hospital.

Case I (Hospital No. 7873). White, male, broom-maker, aged fifty-five years. Patient entered the medical service August 11, 1912, and was transferred to the surgical service August 14. The family history was negative, and the patient's history was negative, except for persistent cough on account of which he entered the hospital. Nine months before admission, he had a sudden pain in the right side and three days later a cough began, which has persisted. In the past nine months he has lost fifty-one pounds. The sputum, 300 to 400 c.c. in twenty-four hours, showed pus cells and mucus, pneumococci, and streptococci, but no tubercle bacilli, no elastic fibers. Examination of the chest showed the right clavicle to be more prominent than the left. Expansion was better on the right than on the left. Scattered râles were heard on both sides. At the angle of the right scapula, extending backward to the spine, was an area of marked hyper-resonance and below this an area of 5 cm. in diameter of moist râles. Surrounding this area of moist râles there was a narrow zone of distinct dulness. The *x*-rays showed a distinct triangular cavity with heavy walls directly beneath the eighth rib. The heart was normal.

First-stage operation on August 15. Under local anesthesia, a flap of skin and subcutaneous tissue about 6 by 8 cm. was turned back at the angle of the scapula. The eighth and ninth ribs were exposed over the site of the lesion as shown by the *x*-rays, and 6 cm. of each subperiosteally resected. The intercostal vessels were ligated and the intercostal muscle resected, exposing the parietal pleura. There were no adhesions of the lung over this area. The lung could readily be inflated by the patient and brought in contact with the parietal pleura. Stay sutures of catgut were placed without difficulty, uniting the

lung to the edge of the exposed area of pleura. Placing the sutures caused no discomfort. A layer of gauze was then spread over the area and a skin flap loosely approximated with superficial sutures. Six days later, the flap was turned back without an anesthetic, and, after several exploratory punctures of the aspirating needle, the cavity was found slightly upward and backward from the exposed area of pleura. A grooved director was then inserted and this tract dilated with a clamp. A large amount of foul-smelling pus escaped. A rubber drainage tube was then inserted.

Following the operation, large amounts of foul-smelling pus and necrotic pieces of lung tissue were discharged daily, but the patient was comfortable and much relieved of his cough. Within two weeks after the operation the amount of discharge began to diminish rapidly, and three weeks after operation he was discharged from the hospital, having gained twenty-six pounds in weight and rarely coughing up any sputum. In January, 1914, the patient reported that his sinus had closed very soon after leaving the hospital, that he had returned to normal weight, and had been in perfect health since the operation.

Case II (General Hospital No. 9738). Negro, male, laborer, aged thirty-seven years. Entered the medical service September 11, 1912, on account of persistent cough and large amount of sputum. He was transferred to the surgical service September 13. Family history negative. Patient's history not remarkable, except for the cough, on account of which he came to the hospital. Fifteen months previous to entrance he had pneumonia. Ever since then had been troubled with a persistent cough. One month after pneumonia, he began to cough up a considerable amount of sputum, and stated that he had coughed up blood. At one time he thought that he had night sweats, but had had none recently. Had lost thirty-two pounds in weight. Examination showed a markedly emaciated negro. The heart was negative. The chest in front showed marked depressions in the infra- and supraclavicular regions. The breath sounds at both apices were harsh, more marked on the

right. Vocal and tactile fremitus was present on both sides. The left back was not remarkable. On the right side extending from the level of the fourth rib down to the tenth rib along the spinal column, extending out under the scapula was an area of diminished resonance. There was no "cracked-pot" sound. Below this area of diminished resonance, there were numerous râles. The sputum varied from 450 to 650 c.c. per day. It was foul smelling, and had no elastic fibers, and consisted largely of pus. There were no tubercle bacilli, but numerous cocci. The *x*-rays showed the irregular outline of a cavity extending from the fifth rib down to the ninth, with a zone of uninvolved lung between the cavity and the spine.

September 16, with morphin and novocain infiltration, a V-shaped skin and muscle flap with the base toward the spine and extending out over the scapula was turned back. The sixth and seventh ribs thus exposed were resected, the scapula being drawn forward. The intercostal vessels were tied, and the lung sutured to the parietal pleura. There were some adhesions between the parietal and the visceral pleura, but these were not sufficiently dense to warrant opening of the abscess. The visceral pleura was then excised, leaving the lung surface exposed. One layer of gauze was placed over this exposed area and the flap held loosely with stay sutures. The patient was in no way disturbed by the operation. A few days later the flap was again elevated, the abscess located with an aspirating needle, and the tract dilated as in the previous operation, a drainage tube being inserted. On opening the cavity, a large amount of foul-smelling pus was discharged.

Four days after the operation, the amount of sputum had decreased by 200 c.c. Until this time, the postoperative convalescence had been satisfactory. Following this, the condition did not improve, the urine showed increased number of pus cells and some casts. Ten days after operation, there was a sharp attack of tonsillitis accompanied by enteritis. On the next day there was a severe hemorrhage. The dressings were saturated with blood and a considerable amount was expecto-

rated. There was another severe hemorrhage the following day, and 13 days after operation the patient died, immediately after the third severe hemorrhage. No autopsy was obtained.

The only difference in the technique of the two operations was that in the second the parietal pleura was excised. This I think offers no advantages, and does add to the difficulties of the operation. In the second case, though no tubercle bacilli were found, the history and the *x*-ray findings are suggestive of a tuberculous process. No attempt was made to pack the cavity with gauze, it being thought that in the extreme condition of the patient any interference was contra-indicated.

These cases illustrate no new method of operating, and the advantages of local anesthesia have been fully appreciated by many.[6] They are reported because too generally surgeons continue at least to complicate, and, I believe, to really increase the dangers of operations for draining abscesses of the lung by failing to recognize the essential factors of the operative procedure. Non-tuberculous abscesses of the lung should be treated on the same general surgical principles as any other abscesses, and drainage instituted by such means as to limit, so far as possible, the further spread of the infection, and to conserve the strength of the patient.

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PULMONARY ABSCESS AND BRONCHIECTASIS

A CLINICAL REPORT

By HOWARD LILIENTHAL, M.D.
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Since the application of intratracheal anesthesia to the human being early in 1910, with the simplification of differential pressure methods in endothoracic operative work, I have been greatly interested in the new possibilities of lung surgery. Believing that there is a peculiar interest and value in studying the methods and results of an individual surgeon, I venture to offer a series of histories and notes representing my own work since 1910 in cases of lung abscess and bronchiectasis.

There have been a number of other thoracic cases, but I have limited this paper to a consideration of the suppurative non-tuberculous lung infections.

There were fourteen operations on eleven patients, and there were but three actually "*cured*." Two cases are still unfinished and cannot be included in my table, though I present abstracts of their histories. One patient was not operated upon.

Five operations were followed by visible improvement, and there were four deaths.

Two of the fatal cases (VI and VII) I consider to have been hopeless. One of the other two might have survived for a time (Case II) had I been satisfied with a mere "operative" recovery. Case VII might perhaps have recovered with better technic.

Of the eleven patients operated upon five had bronchiectases, and of these one patient died in the hospital. The others

were more or less improved. One died about a year later of hemorrhage.

There were three cases of acute abscess and two of the patients recovered.

One of chronic abscess recovered.

One of acute extensive gangrene died.

One of fetid bronchitis with minute abscesses died.

Hemorrhage (hemoptysis) was prominent in four of the bronchiectatic cases, and in these resection of the thorax certainly did result in benefit, in two of them the tendency to hemorrhage having been temporarily checked. Indeed, obviously insufficient attempts were several times followed by decided improvement, both subjective and objective (lessening of the amount of expectoration).

Clubbing of the fingers was a prominent phenomenon in the chronic cases, the appearance even in little children being most striking (see Fig. 1).

In trying to arrive at an exact differential diagnosis of chronic intrapleural suppurations it must be remembered that as a working rule all may be regarded as "lung abscesses." A lung abscess may begin outside the lung itself, as, for example, in an empyema, and the secondary abscess may even drain itself through a bronchus. Occasionally the radiograph may show a level surface-line with clear space above and opacity below (see Fig. 2). But when it comes to the operation we must be prepared for surprises.

The surgeon must possess that quality of mind known as *imagination*. He must have the faculty of producing a distinct mental image showing, as it were, the physical characteristics of the object with which he has to deal. He must have in his mind a picture of the morbid part formed with the help of all the diagnostic aids at his command—and at the same time he must keep an open mind and change his preconceived idea and also his plan of action as the progress of the operation or of the disease indicates previous error.

Although bronchoscopy was practised in but two of the cases

a

b

FIG. 1.—Photograph and radiograph of hand of F. W., Case XIII. Clubbing of fingers with no visible change in the bones.

in this list, I have had the advantage of this important diagnostic aid in several other cases and shall employ it when feasible whenever a pulmonary operation is contemplated. In addition to the possibility of finding an unsuspected foreign body some points of pathological anatomy can be cleared up with a certainty at least as great as that achieved in urological cases by cystoscopy.

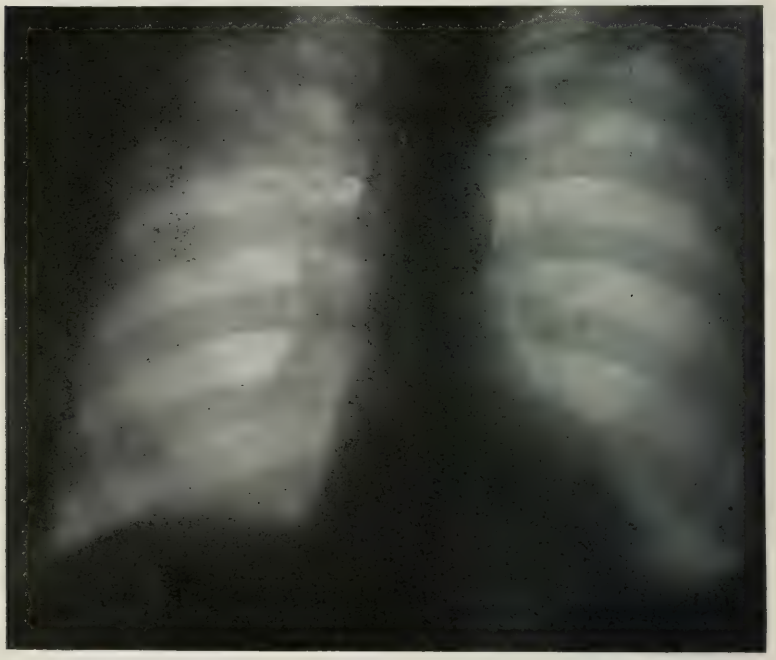

FIG. 2.—Abscess partly filled with fluid. Note line of liquid level. Right upper lobe. (This patient was not operated upon.)

My attempts at cure by operation were, first, thoracotomy and drainage.

Second, thoracoplasty for reducing the capacity of the affected side.

Third, extrapleural tamponade (Tuffier).

Fourth, extirpation of the affected part of the lung.

I have been surprised in some of my cases, especially those of bronchiectasis, at the tremendous toughness, thickness, and rigidity of the inflammatory tissues surrounding the diseased focus. This point is enough to convince one of the futility of treating these cases by artificial pneumothorax and to make one doubt the efficiency in indurated bronchiectasis of Tuffier's method of extrapleural plugging, which he has so successfully employed in apical tuberculosis.

Briefly, this operation consists in the careful digital dissection of the unopened apical pleura from the endothoracic fascia through an intercostal incision; the forcing downward of the entire apex compressing the lung tissue so as to leave a great hollow where the apex was; then the implantation of living tissue, either fat or benign tumor substance, so as to fill completely the dead space; finally, the closure of the wound by suture. I would suggest as a name for this ingenious operation biotamponade - or if fat is used, lipotamponade.

In old cases of fetid bronchiectasis with the usual mixture of bacterial strains and with intimate adhesion between the visceral and parietal pleuræ there is a very real danger of infecting the tissues surrounding the newly made extrapleural cavity even without breaking into the septic focus. This danger is obviously less when we are dealing with a pure tuberculosis.

The two-stage operations in certain forms of true lung abscess may be an advantage. At first the free pleural cavity is opened, inspected and palpated, and the extent and character of the disease ascertained. A few days later the drainage operation may be undertaken with increased accuracy and better chances of success. The general pleural cavity can be well protected, even in the neighborhood of suppuration (see Case VIII and Case IX).

If the operation is to be performed with a view to resection of the diseased lung, however, one sitting is best.

Differential pressure, however attained, is a valuable aid in chest surgery, but it must be understood that most of the commoner operations upon one lung can be done with anesthesia managed in the ordinary way.

No major work through the thoracic cavity should be undertaken without full narcosis.

Anesthesia by intratracheal insufflation has been a great comfort in many of these cases and its application tends to become simpler. Still, in spite of the beautiful, almost automatic, character of this method of anesthesia it is far from "fool-proof," and there should be the most scrupulous attention to details. The apparatus must be tested immediately before using it. A supplementary bellows must be at hand in case the electricity fails, a woven trachea tube of proper size ($\frac{1}{3}$ to $\frac{1}{2}$ the calibre of the trachea) must be selected and inserted under the guidance of the eye. During the entire operation the air pressure and the strength of ether mixture must be carefully observed. Even when everything is running smoothly and the patient's color is good the pressure should be completely shut off a few seconds every minute. And there are a number of other points which it is not necessary to mention here. However, the technique is not difficult to acquire and it can be well studied in the ordinary run of surgical cases in which the differential pressure element is not an essential factor.

REPORTS OF CASES WITH CRITICAL REMARKS

CASE I.—*Bronchiectasis.* B. F. Exploratory thoracotomy in intratracheal anesthesia.

The history of this patient has been reported and may be found in the *Annals of Surgery* for July, 1910. It was the first case in which thoracotomy in a human being had been performed with the aid of intratracheal anesthesia. The disease had been characterized by the usual profuse expectoration and by severe attacks of pulmonary hemorrhage. The operation was an exploration which revealed the site of the tough adhesions in the right subscapular region (indurative bronchiectasis—Hoffman). The hand within the thorax, aspiration through the sound chest wall was practised, but the abscess could not be found by this

means. For some reason improvement followed this insufficient operation but the patient died of a hemorrhage a few months later.

CASE II.—*Bronchiectatic abscess; thoracoplasty; infection of opposite lung. Death.* I. B., a boy aged nineteen years, was referred to me on August 11, 1911, by Dr. James A. Miller, from his service at Bellevue Hospital.

Eight months before his illness had begun with pain in the right chest, cough, and fever. No tuberculosis.

When he came to me he was in good general condition though there was some cyanosis. His breath was very fetid and there was a daily expectoration of eight ounces, the patient often vomiting from his cough.

The pulse was normal, the temperature rising at times to 100°. Over both chests were numerous moist rales but the right base appeared to be most involved. Below the tenth rib posteriorly on the *left* side there was impaired resonance.

A radiograph by Dr. Hirsch disclosed a shadow representing the diseased area in the right chest.

Operation. On August 17, 1911, at Bellevue Hospital, the patient in ether anesthesia, I resected sections of two inches or or more from the seventh, eighth, ninth, and tenth ribs, my incision being parallel with the border of the latissimus dorsi muscle. The pleura was not violated.

While this operation did not diminish the quantity of sputum, its character changed and became nonodorous and more mucoid. The temperature ranged about 99° F.

In March, 1912, the patient entered Mt. Sinai Hospital for further treatment because of repeated severe hemorrhages.

An *x*-ray picture at this time showed some clearing of the former shadow but there was opacity in the right base up to the ninth vertebra. The general condition and weight had improved greatly after the operation but had then deteriorated. Expectoration about four ounces a day.

On April 12, 1912, I removed large sections of the second, third, fourth and fifth ribs in the axillary line, the anesthetic being ether administered by intratracheal insufflation. The patient's

color remained excellent during the anesthesia, but directly afterward there was deep cyanosis continuing for some hours. For about two weeks there seemed to be improvement, but the left lung became acutely infected and he died on May 16. Unfortunately no autopsy.

Critical Note. Another discouraging case. The question comes up as to the possible influence of the intratracheal insufflation in the appearance of the acute process in the left lung, although it must be borne in mind that this lung was far from normal from the beginning. Still, the second operation under the insufflation was no more severe than the first in ordinary anesthesia. Perhaps the tube was too large in spite of its careful selection. That injury to the lung can occur from intratracheal insufflation is well known, though a proper sized tube and attention to details of pressure with periodic collapse of the lungs should make the accident a rare one.

Case III.—*Bronchiectatic lung abscess; resection of ribs and attempted drainage.* G. R., aged thirty years, had been sick for nine weeks with pain in the right upper chest, cough, profuse and extremely fetid expectoration, fever, vomiting, one chill, and night sweats. There had been much loss of weight and three slight hemoptyses.

He was referred to me by Dr. James A. Miller, who stated that the case was very probably non-tuberculous, a number of sputum examinations having been negative.

The blood showed 18,000 leukocytes with 90 per cent. polymorphonuclears.

On February 6, 1912, he was admitted to Mt. Sinai Hospital.

There was fetid expectoration amounting to about 200 c.c. in twenty-four hours. Cough and expectoration occurred at once when the patient lay upon his left side. There was dulness in the right posterior chest from about two finger breaths below the angle of the scapula. Prolonged expiration at the upper level of the dulness, with harsh breathing and coarse, sonorous and sibilant rales below this point.

Radiography showed an opacity in the right upper chest

reaching almost to the apex of the right lung but not entirely obliterating the normal transparency at this point. The opacity was as large as an adult human palm.

Dr. Miller stated that he had aspirated the suspected area and had secured a few drops of thick mucopurulent material.

On February 16, in intratracheal anesthesia with ether, an incision was made along the border of the latissimus dorsi beginning almost at the apex of the axilla. Sections of the third, fourth and fifth ribs were removed here and the chest opened. The pleura was free everywhere except posteriorly and the area above indicated where there were dense adhesions. The lung and parietal pleura were united by a running catgut suture except posteriorly where the adhesions existed as stated. A large aspirating needle was then plunged repeatedly into the indurated mass but failed to reach a pus cavity.

About six days after this operation I punctured the site of the supposed abscess a number of times through the wound. The result was persistently negative. The patient, however, continued to improve, expectoration amounting to less than 200 c.c. in twenty-four hours, and there was an increase of seven pounds in weight. On March 20 he was discharged from the hospital, the wound healed. His sputum then amounted to 100 c.c. in the day. He was subjectively and objectively improved.

Note. There is nothing remarkable about this case unless it be the fact that as in Case I an insufficient operation was followed by unexpected improvement. I proposed further surgery to this patient but he regarded his condition as tolerable and therefore he refused.

Case IV.—*Bronchiectatic abscess; thoracotomy and drainage; multiple rib resection.* On December 17, 1912, this patient, Harry G., aged twenty-three years, was transferred from the medical service of Dr. Manges at Mt. Sinai Hospital. He had been ill for six months with cough and profuse foul expectoration—always more abundant in the morning. There had been eight hemoptyses, much blood being lost each time. There were occasional slight attacks of fever.

On physical examination, there was dulness with hard breathing and inconstant "sticky" rales in the right axilla. The patient had clubbed fingers. His general condition, however, was excellent as to nutrition and musculature.

The temperature was normal, the pulse 80, and the respiration rate 24.

FIG. 3.—Anterior radiograph demonstrating extent of bronchiectatic mass. Compare with Fig. 5.

A radiograph made by Dr. Jaches, on December 7, 1912, revealed a sharply defined, oblong shadow opposite the base of the heart, with a prolongation upward and outward. There was also a narrow shadow passing downward and outward (see Fig. 3).

Operation. On December 20, 1912, in intratracheal anesthesia, an incision was made parallel to the fibres of the latissimus

dorsi muscle in the right posterior axilla. A four inch section of the fifth rib was removed and an attempt was made to enter the pleural cavity. Adhesions all about, however, showed a complete walling off. A section of the fourth rib was removed, also without entering the general pleural cavity, and a needle puncture withdrew a small quantity of fetid pus. A narrow opening was made with the scalpel and then with dressing forceps the extremely tough and dense membrane surrounding the abscess itself was torn apart, the dressing forceps on withdrawal widening the opening into the cavity. Explored with the finger there were evidently many loculi and the case was considered one of bronchiectatic abscess. But little pus escaped this time. The abscess was very deep and lay next to the anterior chest wall. The entire wound was now packed with gauze and the patient sent back to bed with the intention of subjecting him to further operation at another time. The anesthesia had been excellent throughout, although some blood and pus had appeared at the patient's mouth during the operation.

Ten days later the patient was anesthetized in the usual manner with nitrous oxide and oxygen and in the hope of reaching the bronchiectasis more directly about two inches of the fourth rib were resected at its anterior inner portion. To my surprise, upon incising the chest at this point I found that I had invaded the free pleural cavity. It was quite clear that the former operation had drained the abscess as far as was possible, so the opening in the pleura was packed and the remainder of the wound was sutured. A tube was later placed in the abscess cavity and suction maintained with the apparatus referred to in Case IX. The patient's condition now improved every day but he still daily expectorated from three to five ounces, the only difference noted being that the discharge was less purulent and more mucoid than it had formerly been.

The wound healed and the patient was sent to a convalescent home. His general health was good but the cough and expectoration for which he sought relief had been influenced but little.

Nearly a year after the first operation this man presented

himself again, saying that he was unable to work and that the foul discharge from his lungs made him so miserable that he was willing to submit to anything rather than continue as he was.

On November 21, 1913, in ether anesthesia by inhalation, I removed sections from the fourth, fifth, sixth, seventh, eighth and ninth ribs through a long posterior incision. The inner bone-sections were made just to the spinal side of the costal angle and the amount resected was about two and one-half inches from each rib. The pleura was not injured. The wound was closed by suture with tube drainage above and below. While hemorrhage had been free it was not near the danger line. The chest wall was thoroughly strapped so as to approximate the cut ends of the ribs and reduce the size of the thoracic cavity.

Another examination of the sputum was negative for tubercle bacilli. A culture by Dr. H. Plotz, of the pathological laboratory, showed bacillus mucosus capsulatus and from this a vaccine was prepared and given. Highest dose one billion. The patient thought he noted improvement following this therapy. There was now steady progress but by no means a cure. The patient's general condition was very good and his "emptyings" occurred usually but once a day—in the morning. The discharge was not as foul as it had been and the quantity was seldom more than three and one-half ounces.

The case is not yet finished and I hope to improve his condition still further, perhaps by completing the Wilms' operation, resecting the ribs anteriorly, or possibly by attempting the extirpation of the well localized infection.

Because of recent published experiences and because Dr. Yankauer had found and removed an unsuspected foreign body from the bronchiectatic cavity of an old man in one of the medical services, H. G. was bronchoscoped before his discharge from the hospital but nothing was found. The diagnosis of bronchiectasis was, however, confirmed.

A glance at the photograph (Fig. 4) gives an idea of the man's general condition and also shows the degree of deformity produced by the operation. The *x*-ray (Fig. 5) shows the degree of collapse which was attained.

FIG. 4.—Case IV. Result of posterior thoracoplasty. Compare with Fig. 5.

FIG. 5.—Posterior radiograph showing reduction in the capacity of the right chest following thoracoplasty. Case IV.

Note. I am by no means proud of this result even though it compares favorably with many of those reported in recent literature. If we ever are to accomplish anything like an actual cure in these almost hopeless cases it will be by means of direct surgical attack with the actual removal of the bronchiectatic mass.

Case V.—*Bronchiectatic abscess; transpleural drainage.* A. S., a woman aged twenty-six years, had been well until March, 1912, when she had "pneumonia" followed by left empyema for which she had been operated upon in another hospital. She had been sent home "well" but there was a relapse and a discharging sinus persisted. At the time of her operation she was coughing up enormous quantities of pus.

She entered Mt. Sinai Hospital on April 19, 1913. The left lung was entirely dull and in its lower third flat. There were bronchial breathing and numerous rales.

There was a deep sinus in the posterior axillary line at the level of the eighth rib and when the patient coughed there was a mucopurulent discharge.

X-ray by Dr. Jaches showed in the left chest one homogeneous shadow, denser below.

On May 26, 1913, in ether intratracheal anesthesia, I made long resections of the sixth and seventh ribs in the postaxillary region but extending far toward the back. A honeycomb cavity fully as large as a man's fist was exposed, the walls lined with sluggish granulations and showing five separate bronchial fistulæ of various sizes. The tough pleura on the costal side was resected and the huge cavity was packed (see Fig. 6).

The patient made rapid improvement and the wound again shrank to a sinus, which was in truth a mere bronchial fistula discharging opalescent mucus when the patient coughed. She was discharged three months after the operation.

Twelve weeks later, November 15, 1913, there was an infection of the sinus with constitutional symptoms. Under suitable dressings the bronchial fistula regained its "normal" condition.

Critical Note. This case illustrates the futility of expecting a radical cure of these bronchiectatic cavities by ordinary drain-

age, no matter how perfect. The walls are rigid and the bronchial openings cannot fall together nor do they granulate. I repeatedly tested the various escharotics and the actual cautery through the ample opening but with no good effect. In another case—perhaps even in this one—an attempt might be made to dissect out a stump of each bronchus from the wall of the cavity, crush it and ligate in the hope that granulation tissue might then form and lead to a permanent closure.

FIG. 6.—Drawing from sketch, Case V. Note the size of the wound and the five bronchial openings. Even this thorough drainage did not result in cure.

CASE VI.—*Diffuse pulmonary gangrene; hemopneumothorax; thoracotomy. Death.* H. A., a man, aged forty-eight years, and previously healthy, was seen by me in consulation with Dr. D. H. Davidson on October 11, 1913, after two weeks of what had been diagnosed left septic pneumonia. The disease showed no tendency to clear up and the entire left chest was flat to percussion.

Aspiration by the attending physician withdrew foul sanguineous fluid which under the microscope showed no white cells but granular detritus, bacteria, and blood pigment with broken down blood-cells. The heart was but little displaced. Patient icteric and septic with pulse 120 and temperature 104°. There was little cough and no foul odor from the mouth.

A few hours later, in local anesthesia, I resected the eighth rib in the posterior axillary line, evacuating much fluid, clot, and fetid gas.

Next day I was able to get a good view of the lung itself which was dry and obviously gangrenous as far as the eye could see. The pleura also was sloughing and a whistling sound within the chest indicated an opening into the lung. The wound remained dry and necrotic, delirium supervened and four days after operation death occurred. No postmortem.

Note. This case is of interest principally because of the absence of physical signs indicating pneumothorax. The entire chest in all postures was absolutely flat to percussion, yet there was much gas under pressure in the pleural cavity. The character of the aspirated fluid and especially the absence of pus cells led us to diagnose perforation of the lung before operation. I have seen the same non-cellular foul sanguinolent fluid in a chest some days after a gunshot injury of the lung. Judging by the great extent of the lung necrosis this case was hopeless from the first. It was one of those cases, rare on the operating table, in which there was gangrene without suppuration.

Case VII.—*Acute abscess of the lung; thoracotomy and drainage.* About seven months before admission to Mt. Sinai Hospital, Harry L., aged forty-one years, had been seized with a malady accompained by a severe cough with fetid expectoration, following undue exposure to cold. There was fever and loss of weight. The amount of expectoration was as much as eight ounces in a day. There had been no night sweats.

He was transferred from the medical service of Dr. Alfred Meyer on March 29, 1912, after a residence of several weeks in the hospital. During this time his temperature had rarely risen

to more than 100°. Repeated examination of the sputum had failed to disclose tubercle bacilli but there were distinct evidences of pulmonary disease of the upper portion of the left chest.

An *x*-ray examination on February 7 showed a distinct circular shadow below the left pulmonic apex and apparently nearer the back of the chest than the front (Fig. 7).

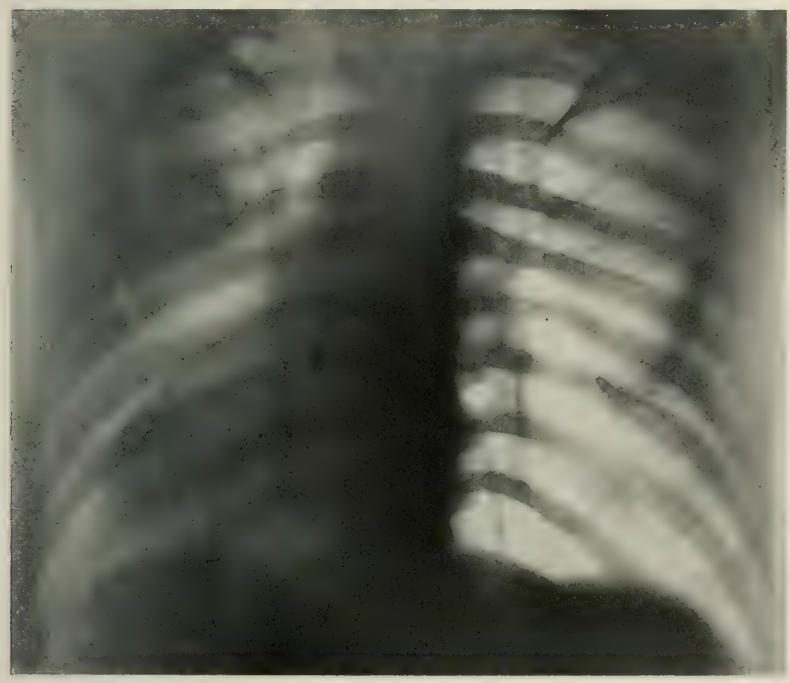

FIG. 7.—Posterior radiograph. Putrid abscess of left upper lobe. Case VII.

About March 22 and 23 the patient began to have high fever with alternating drops of temperature, but the sputum was still negative for tubercle bacilli and the white blood count was normal. On March 29 Dr. Meyer had aspirated pus through the anterior part of the chest.

The same afternoon under ether administered by the intratracheal insufflation method, I made an incision beginning near the apex of the axilla and running parallel to the border of the

latissimus dorsi muscle for about six inches. The serratus magnus was divided at this place. Sections of the third, fourth, and fifth ribs were removed over an area the size of the palm of the hand. Careful dissection between mouse-tooth forceps showed that the pleura was intimately adherent to the lung. Aspiration of the abscess was followed by a free opening made with the dressing forceps, the general pleural cavity remaining uninvaded. On digital exploration there was thorough walling off, although from the large quantity of pus expectorated it was most probable that an opening into the bronchus existed. The abscess cavity was irrigated, then lined with a pouch of rubber dam which in turn was filled with gauze. Iodoformized gauze was packed into the external part of the wound and a few sutures were placed in its lower part. During the operation there had been a considerable discharge of pus and mucus from the mouth. The patient was sent back to the ward in good condition.

Although during the next forty-eight hours the temperature came down, the patient was in a very uncomfortable and serious condition, owing to the gathering of large quantities of discharge in his trachea. This he seemed unable to expectorate although on observation it appeared that he raised and swallowed the discharge. Periodically the foot of the patient's bed was elevated eighteen inches and he was turned upon his face in the hope that this might facilitate the bringing up of the pus.

Four days after the operation the patient died, evidently of a pneumonic process, probably near the site of the abscess. No autopsy was permitted.

Critical Note. Apparently a serious secondary infection with putrid abscess had begun when the temperature rose just before the operation. The patient's condition then seemed grave.

One technical error was committed—namely, the irrigation of the abscess cavity. It has been pointed out by Garré and Quincke that this procedure is particularly hazardous because of the danger that septic fluids may enter bronchi which until then have escaped or that the infection may even run over into the healthy lung. And it appears to me that even with the advantage

of intratracheal anesthesia fluid introduced in great quantity, as by irrigation, may not be blown out of the mouth quickly enough to prevent extensive septic flooding.

CASE VIII.—*Acute abscess of the lung; thoracotomy and drainage* Miss E. B., aged twenty-four years, had been well until September, 24, 1912, when she had an attack of what was called la grippe. The most annoying symptom was pain in the external anterior part of the right chest at about the level of the third or fourth rib, and this point was also very tender to the touch. For four weeks the patient ran an irregular temperature, the pain and tenderness persisting.

I saw her with her physician, Dr. Manges, on October 12, in the private pavilion of Mt. Sinai Hospital. Aspiration had been performed a few days before when a little slightly clouded serum had been withdrawn. Subsequently aspiration was, however, negative. A Röntgen picture suggested fluid to the level of the seventh or eighth rib in the right chest (Fig. 8). The patient's condition was wretched. There was mucopurulent blood-tinged expectoration, cyanosis, and dyspnea.

In nitrous oxide and oxygen anesthesia, I aspirated repeatedly in the posterior axillary region but with negative result. I then made an incision parallel to the border of the latissimus dorsi muscle and removed generous sections of the eighth and ninth ribs opening the pleural cavity for inspection. There was no fluid and there was but one firm, dense adhesion binding the lower lobe anteriorly to the chest wall. Otherwise, although the right lung appeared to be covered with a rather thin layer of grayish membrane, there were no adhesions.

The peculiar grayish appearance of the diaphragm was so remarkable that I excised a minute piece of it under the impression that its examination might prove useful. The muscle was, however, so extremely thin that the tiny opening spread until it was fully as large as a dime. I closed this by a single mattress suture. The chest wound was now also closed, a piece of gauze being left as a packing down to the adhesion which I have mentioned. At the end of the operation it was found that the patient had had a considerable discharge of blood from the mouth.

There was a decided improvement in the general condition following this merely exploratory procedure and the wound healed kindly without the occurrence of intrapleural suppuration. The pain in the anterior chest, however, did not disappear and cough and expectoration continued. The temperature rarely rose now to a point beyond 101°. There was considerable improvement in nutrition.

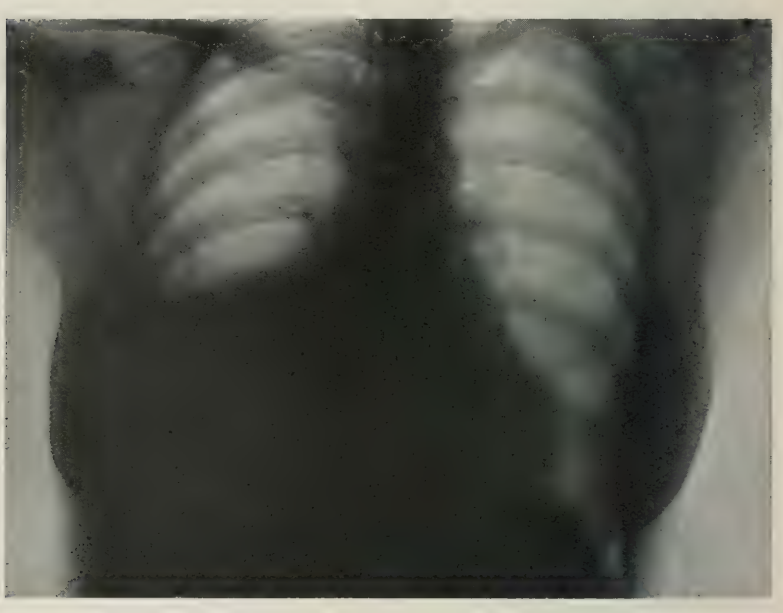

FIG. 8.—Acute lung abscess. Note pseudoliquid level. There was no free fluid in this chest. Case VIII. Miss E. B.

About the tenth of November a point of induration was noted just beneath the right mamma, and four days later, in nitrous oxide anesthesia, a long incision was made in the inframammary fold and pus was encountered here outside of the chest itself. The mamma was turned up off the chest wall and the origin of the flow of pus was found in the nipple line just below the fifth rib. A section of this bone was removed and the finger could easily explore a sponge-like abscess about 30 c.c. in extent. A

tube was put in as a drain and the submammary exposed space was lightly packed with gauze.

Convalescence from the operation was rapid and the patient was discharged from the hospital in a month. A few weeks later healing was complete. The inframammary cicatrix was most unobtrusive.

Note. In the case just reported the exact diagnosis was in doubt. Referring to the radiograph (Fig. 8), the straight horizontal limit of the right chest shadow strongly suggested fluid-level—yet this appearance must have been caused by something else unless we can imagine that an extremely thin layer of liquid exudate could have caused it. Comparing the density of media in the two "clear" parts of the chest there is no hint of compression on the right side such as we might have expected had fluid forced the lung upward.

My first operation was truly an exploration and it accomplished the localization of the abscess and gave knowledge as to the extent of the adhesions, so that at the second step I resected the rib without fear of invading the uninfected part of the pleural cavity. I have since made use of this same double operation with success.

Case IX.—*Abscess of the lung complicating paratyphoid fever: thoracotomy, and drainage.* On December 22, 1912, N. S., a man aged twenty-two years, was transferred from the Rockefeller Hospital to Mt. Sinai Hospital with a diagnosis of empyema in the course of paratyphoid fever.

The history abstract stated that he had also been treated at the Rockefeller Hospital for what appeared to be a complicating lobar pneumonia. He had been aspirated in the seventh interspace at the right scapular line and 20 c.c. of thick, greenish pus had been obtained.

On examination there was dulness below the fourth rib anteriorly and beneath the level of the eighth dorsal spine posteriorly. Breath sounds over the flat area were diminished or absent. Fremitus was increased.

The white blood cells were but 10,200, the temperature was 101°, the pulse 100, and the respirations 24.

The patient still suffered from his paratyphoid infection and was acutely ill.

On the following day he was anesthetized with nitrous oxide and oxygen and I resected the seventh rib where it crossed the border of the latissimus dorsi muscle. Before making the incision aspiration was practised and only on very deep puncture toward

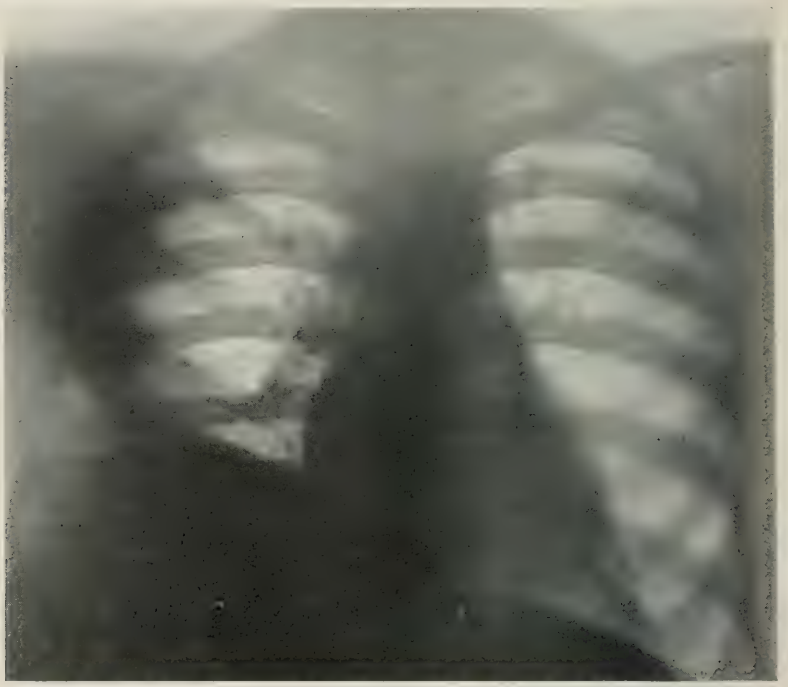

FIG. 9.—Case IX. Large putrid abscess right lower lobe. Probably from a subdiaphragmatic source.

the base of the chest was pus obtained. Entering the chest after the rib resection there was no fluid and there were no adhesions, except of the right lower pulmonary lobe to the diaphragm and outer chest wall. Under the guidance of the eye an indurated place in the right lower lobe was aspirated and pus obtained. It was then determined not to evacuate the abscess at this sitting. Instead, a portion of the eight rib was also excised so as to make

the opening into the chest ample. Gauze packings were put in so as to cause the formation of adhesions between the parietal and visceral pleuræ above the abscess, with a view to evacuation at a second sitting.

Four days later the patient was again taken to the operating room and without anesthesia the central packing, which went down to the abscess, was removed, leaving the "walling off" packing undisturbed. The opening was large enough to permit of aspiration with the aid of sight through the very thick firm-walled abscess, and pus was again obtained. The scalpel was now carried down to the point where the needle entered the lung and the abscess wall, tough and almost cartilaginous in feel, was incised and the opening enlarged with dressing forceps, but the fluid was evidently not under very great tension and it was not until the patient was turned upon his side that a large quantity of extremely foul and thick pus poured out in a syrupy stream. A large sized drainage tube was carried several inches into the cavity which was irrigated and new packings were placed around that part of the tube between the thoracic wall and the actual opening of the abscess.

The culture from the laboratory was reported "streptococcus" (examined by Dr. P. Aschner).

On January 8, 1913, twelve days after the evacuation of the abscess, the last of the walling-off packing was removed, much force being required to detach it from the pleural adhesions. Now local improvement set in but the constitutional symptoms were still severe, the temperature often reaching 105°. The wound was apparently divided into two parts, the first being virtually an encapsulated empyema, the actual lung abscess being entered by an opening just about large enough to fit the tube and this opening was almost a finger's length from the surface. On account of the very rigidity of the abscess walls drainage was not easy. The patient was now transferred to a bed on the roof and a suction apparatus was improvised with the aid of a vacuum cleaner and a bottle for collecting the discharge. This was kept going day and night and I believe contributed greatly

to the comfort of the patient and to his convalescence. The wound was healed in the latter part of April and the patient was sent to a convalescent home in the country. He gained rapidly in health and strength, although his cough was slow in disappearing. In June the cicatrix broke down and discharged for a few weeks but closed spontaneously and the man has remained in excellent health ever since.

Note. In spite of the history of pneumonia and the careful examination made by the Staff of the Rockefeller Hospital, it appears to have been impossible to make an accurate pre-operative diagnosis in this complicated case. The suspected empyema turned out to be a lower lobe abscess and though there was no sign of subphrenic suppuration before operation it may well be that an infection of this kind existed with slow boring of pus into the chest and into the adherent lung on its way toward a bronchus whence, had the patient's strength held out, evacuation through the mouth might have resulted.

Drainage by the use of the vacuum cleaner surely benefited this man—and for some days the same device with two tubes sufficed to empty the abscess of H. G. (Case IV), the one machine doing double duty. I now make use of a special pump suction devised by an instrument maker. This apparatus consists of an electric pump, a vacuum tank, and a gauge for regulating the suction power. The pump acts intermittently, ceasing when the required vacuum in the tank has been secured and starting automatically when necessary to keep up the requisite exhaustion of air. The machine is quiet and requires but little attention.

A case of interest in comparison with N. S. is here recorded.

Case X.—A. M., aged thirty-five years, a physician, was referred to me by Dr. James A. Miller, on January 8, 1913.

One year before he had been operated upon for chronic appendicitis. There had been primary union, but at the end of a week he had what was called "paralysis of the bowels." He was up and about six weeks after the operation but he walked with his body bent to the right. Suddenly, about this time he coughed up a large amount of pus. Ever since then he had had attacks

of coughing and raising mucopus sometimes with blood, the whole never amounting to more than four ounces in a day. Occasionally a whole month would pass without cough. When the abscess filled he had fever.

A radiograph made by Dr. Lewis Gregory Cole is here reproduced (Fig. 10). Quoting in part from Dr. Cole's report, "There is a thickening around both roots and one of the branches of the

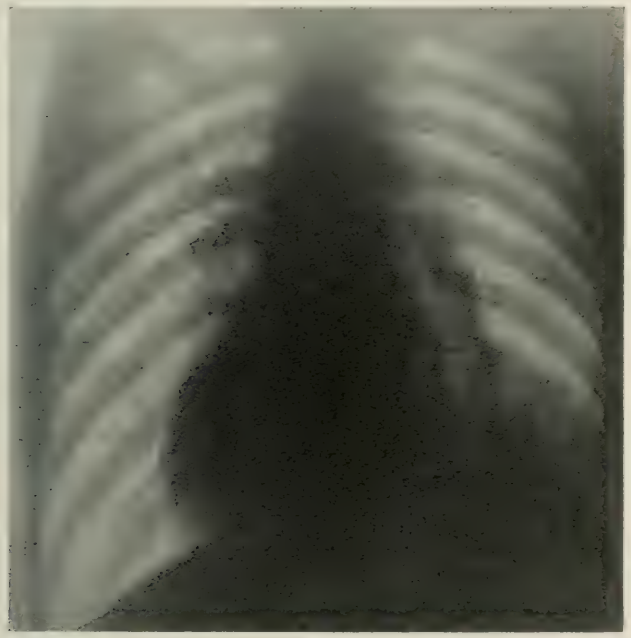

FIG. 10.—Case X. Showing capacity in right chest probably indicating course of subdiaphragmatic abscess to a bronchus.

right descending bronchi. There is consolidation of the lower part of the right lung obliterating the costodiaphragmatic angle, or the lung may be displaced upward by an accumulation of fluid in this region. The thickening along the branch of the right descending bronchus indicates that this is the route by which this abscess cavity empties. The thickening around the root on the opposite side indicates that there is a slight infection in this

region. There is no evidence of any other abscess in the parenchyma of the lung."

Considering the patient's condition, which was not bad, and the fact that he would go sometimes as long as a month without a discharge from the abscess and without fever, I suggested that a culture should be made from the sputum with a view to autogenous vaccine therapy. A pure streptococcus strain was found at the Sondern Laboratory in June and fifteen injections were taken. On October 21 the patient presented himself looking well. He stated that there had been but one slight attack in four months.

I believe that the prognosis in this case is favorable for a final complete obliteration and cicatrization of this suppurating cavity.

CASE XI.—*Abscess of left lung, upper lobe; thoracotomy and drainage.* The unusual case of V. H., a boy, aged twelve years, is interesting. He had been for some weeks under the observation of Dr. Koplik and had entered Mt. Sinai Hospital late in December, 1912. The history was one of left pneumonia in infancy; tonsils and adenoids removed in 1910. A few months prior to admission he had had a pneumonia and this was followed by chronic cough and an occasional hemoptysis, with pain in the left chest.

The boy looked pale and thin. There was clubbing of the fingers. Physical examination of the lungs showed, posteriorly, dulness at the left apex to a finger's breath below the spine of the scapula. Anteriorly and in the upper axilla there was dulness.

The dull areas showed bronchial voice and breathing with subcrepitant rales over the left supraspinous region. Broncho-vesicular breathing over the left interscapular region.

The blood count:—White cells, 15,000; polynuclears, 54 per cent.; small lymphocytes, 27 per cent.; large lymphocytes, 16 per cent.; transitionals, 1 per cent.; eosinophiles, 2 per cent.

Neither the sputum nor the von Pirquet test gave evidence of tuberculosis.

On December 21, 1912, pus was obtained by aspirating in the left armpit, the needle pointing upward and backward.

Operation. On January 2, 1913, in ether anesthesia, an incision was made from the middle of the clavicle downward two and a half inches, dividing some of the pectoralis fibres. About three-quarters of an inch of the second rib was resected, the aspirating needle forced through the thick, almost cartilaginous, tissues and the abscess opened widely with director and dressing forceps. About three drams of thick, foul pus were evacuated and tube drainage instituted.

Below and to the outer side of the abscess walls normal pleura could be seen moving with respiration.

For two weeks the case went smoothly and the patient improved, the cough diminishing. Then came fever and pain in the wound. Aspiration and digital examination failing to disclose the cause of the continued fever, cough and slight hemoptysis, the patient, on January 24, 1913, was once more anesthetized and guided by a finger in the wound, a needle was passed through the posterior wall of the cavity where a few drops of thick foul pus were obtained. A dressing forceps following the needle was pushed through until its blades could be felt beneath the skin just above the scapula and here a second incision was made. A large drainage tube was drawn directly through the apex of the lung, from back to front. Improvement went on from this time, though progress was interrupted by occasional fever. Fifteen days after the last operation the tube was replaced by three strands of thick silk. Ten days later the silk was withdrawn and the tract filled with Mosetig-Moorhof iodoformized wax. About three months after the first operation the boy was discharged recovered. He has continued in excellent general health, does not cough, and has become big and strong. He has even "grown up to" his clubbed fingers, the deformity having almost disappeared (see Fig. 11).

Critical Note. Surgically speaking, this was a case of lung abscess. Dr. Koplik regarded it as one of apical empyema, but whether or not the case began in the pleura the suppuration was anatomically in the lung, as shown by operation and by the expectoration of pus and by the hemoptyses. I do not regard it

as primarily bronchiectatic but as an abscess caused by pulmonary necrosis in the course of a pneumonia, bronchiectasis perhaps occurring secondarily. The extremely dense, tough wall about the pus sacs —at least two in number—is suggestive of "indurative bronchiectasis."

FIG. 11.—Photograph showing patient recovered after drainage of apica abscess. Clubbing of the fingers no longer present.

CASE XII.—*Fetid bronchitis mistaken for chronic abscess of the lung; extrapleural tamponade with paraffin (Tuffier).* The patient, J. P., a man aged forty-two years. His disease began with cough, slight fever, profuse mucopurulent expectoration and night sweats with loss of weight. Sometimes he vomited after a severe coughing spell. There developed pain in the right chest and the odor of the sputum became foul. The temperature gradually rose until it reached 104° with the pulse rate varying between 96 and 120. Two weeks after the onset he entered Mt. Sinai Hospital on the medical side. This was on August 8, 1913.

The physical examination of the lungs at that time showed dulness with diminished breathing in the right axilla. Posteriorly,

on the right side there was dulness from a point two fingers breadth above the angle of the scapula down to the base, with diminished vesicular breathing and diminished fremitus accompanied by noisy crepitant and subcrepitant rales.

The blood count at this time showed 18,800 white blood cells with 75 per cent. polymorphonuclears, 24 per cent. lymphocytes, and 1 per cent eosinophiles.

The sputum was very abundant, pale yellowish green, and persistently negative for tubercle bacilli.

On August 15, 1913, and again on August 29, an *x*-ray examination was made by Dr. Jaches. The report stated that the right apex showed slight density with infiltration of the root of the lung and with bronchial nodes. At the right base there was a dense infiltration continuous with that of the right lung. The right diaphragm was high (Fig. 12).

The findings on fluoroscopy indicated the presence of fluid in the right costophrenic space. The diaphragm on that side was fixed.

The patient was kept under observation for a number of weeks occupying a bed in the open air on the roof and in excellent hygienic surroundings. There was, however, no improvement—rather a retrogression, although the general condition remained good.

There appeared to be two kinds of sputum: the one not foul, the other extremely fetid. The amount gradually increased until on November 6, 750 c.c. in twenty-four hours were discharged.

Early in November, the patient was examined by Professor Tuffier, of Paris, and his case was pronounced a suitable one for the operation of extrapleural compression.

Some days later bronchoscopy was performed in local anesthesia by Dr. Yankauer. At this time there was no sign of bronchial dilatation nor was there at the time of the bronchoscopy any discharge of foul pus. Dr. Yankauer, therefore, concluded that probably there was a parenchymatous lung abscess communicating with a bronchus, and he believed that at the time of the examination this communication must have been plugged.

On November 7, 1913, in ether anesthesia administered by the intratracheal method, I made an intercostal incision between the eighth and the ninth ribs through the endothoracic fascia to the pleura which was then separated digitally from the chest wall without opening the sac itself. This peeling away of the pleura was done as Tuffier advises—very slowly and carefully.

FIG. 12.—Case XII. Fetid bronchitis mistaken for right lower lobe bronchiectasis.

It was not a difficult procedure. The ribs of this patient, however, were very close together and I wished to avoid the long intercostal incision. In order to gain more space I resected about four inches of the eighth rib. There was finally a cavity formed which I judged to be about 400 c.c. in size. During this procedure there was a discharge of extremely foul pus from the patient's mouth.

Paraffin, with a melting point between 105° and 108°, was then put in—about 300 c.c. in all. I began with the paraffin in the liquid state but this was unmanageable, since it did not solidify quickly enough to prevent its being expelled and, therefore, pieces of soft solid paraffin were eventually employed. The patient stood this operation well although his temperature rose to 105°. The wound was closed without drainage.

The immediate result of the operation appeared to be favorable. The patient expectorated much less than before, but on November 10, on examining the wound there was much bulging and on separating the edges a large quantity of turbid serum escaped. The patient then gradually deteriorated and the septic manifestations became progressively worse.

On November 19 I was obliged to reopen the entire wound without anesthesia and I removed the paraffin, packing the cavity lightly with gauze. Two days later, also without anesthesia, I aspirated the lung, hoping to find the abscess, but without success. Death from his septic chest condition occurred on November 28.

An autopsy through the wound was performed by Dr. Baehr and this brought forth some interesting and suggestive disclosures.

At the site of the operation and, in fact, over the entire right base the visceral and parietal pleuræ were densely adherent. There was found not a single large collection of pus in the lung, but in each lower lobe there were eight or nine small abscesses, most of them from one to two centimeters in diameter and lined by pyogenic membrane. The bronchi to both lower lobes and some to the upper showed intense congestion of the mucous membrane and in some places hemorrhage. All the bronchi were filled with thick, grayish-white purulent material. In addition to the abscesses there were some small areas of gray hepatization and small areas of gangrene, particularly in the right lower lobe. The latter, as well as many of the abscesses, were peribronchial in distribution. In the left lower lobe there were numerous small areas of purulent bronchopneumonia.

I will now quote from the microscopic examination:

"There is a marked thickening of the pleura from which

fibrous bands run into the lungs. The walls of some of the bronchi are infiltrated with polynuclear and round cells. Many of the small abscesses can be definitely seen to have their origin in and about a small bronchus. In addition to the presence of small purulent foci some of the portions of the lung are seen to be completely necrotic."

The bacteriology showed the presence of diplococci, probably pneumococci, some streptococci, and an abundance of Gram-positive and Gram-negative bacilli.

All the time that we thought we were dealing with a bronchiectatic abscess or some other form of lung abscess the disease was in reality a presumably incurable septic fetid bronchitis with its sequelæ of suppuration and necrosis in the lung itself. And this particular error is one which has often been made. (Garré and Quincke.)

The case just reported was one in which there was a complete agreement in the diagnosis among all those who saw the patient clinically. He was supposed to be suffering from "bronchiectatic abscess of the right lower lobe." Yet the bronchoscopy changed all this, for no bronchiectasis was discovered. The case then, in view of the two kinds of sputum, began to look like one of extrabronchial abscess and, indeed, the post mortem findings showed this in measure to be true, though there was no actual fistulous connection between one large abscess and a bronchus. The infection of the operative field is also hardly to be wondered at, remembering the close adhesion of the septic lung with the parietal pleura.

The misreading of the *x*-ray plates is an old story; and nowhere can one be misled more easily than in the diagnosis of intrathoracic conditions.

In a recent case which was in the service of a medical colleague signs pointed to a subdiaphragmatic abscess with lung fistula and the radiograph showed a high rate midriff dome. The patient had expectorated eight ounces of foul pus in one gush. His condition was critical. Tenderness and a mass in

the right upper abdominal quadrant led me to incise here and I quickly emptied a gangrenous gall-bladder. Still the *x*-ray would not permit the idea of subphrenic disease to be put aside. At a careful post mortem examination there was no subphrenic abscess, no liver abscess, no lung abscess! I have, indeed, come to the conclusion that a high diaphragm often signifies a relaxation or paralysis of this muscle in nature's effort to reduce pressure upon inflamed organs, and that its existence is by no means pathognomonic of an exudate beneath.

Case XII. — *Suppurative bronchiectasis; removal of right lower pulmonary lobe.* Francis W., aged two and three-fourth years, had fallen while he was holding some partially masticated nut in his mouth and in the gasp which followed or accompanied his fall some of the foreign material was aspirated with the expectoration of much purulent mucus.

With the aid of the bronchoscope, Dr. Yankauer, New York, had succeeded in removing much of the foreign matter and was finally unable to discover anything more within the visible part of the lung. Bronchoscopy was performed six or seven times during the following year. Still the cough and expectoration continued and now fever and rapid pulse were also observed.

An *x*-ray picture by Dr. Jaches showed opacity at the right base which extended up to the eighth rib (Fig. 13).

The child now entered the surgical department of Mt. Sinai Hospital. He was well nourished but pale and apathetic. There was very marked clubbing of the fingers and toes (Fig. 1). The usual signs of consolidation were found at the right base. The spasms of coughing with the ejection of large quantities of foul mucopus were most painful to watch.

Three times after admission to the Hospital he was bronchoscoped by Dr. Yankauer, and after each bronchoscopy with the clearing out of the cavity there was a remission in temperature. Judging by the amount of discharge at each emptying I had some hope that a Tuffier extrapleural tamponade might tend to improve the drainage in this case and, therefore, on January 23, 1914,

in ether anesthesia by the intrapharyngeal method managed by Dr. Branauer, I made a long incision between the eighth and ninth ribs down but not through the pleura. In order to get more room without making too long an incision I resected a part of the ninth rib, and by digital separation I made a cavity about 40 c.c. in size. Into this I placed three pieces of fat from the

FIG. 13.—Case XIII. Case of bronchiectatic infection of entire right lower lobe.

abdominal wall of another patient and closed the wound without drainage. No improvement followed this procedure, the coughing spells and expectoration remaining about the same. For a few days the temperature remained in the neighborhood of 100° and then there was a sharp rise to 104° with corresponding constitutional symptoms. The wound was slightly infected and slow in healing.

A month later, February 27, 1914, a minute sinus remained. The child's condition was such that something radical had to be done.

Another bronchoscopy by Dr. Yankauer enabled him to see all the bronchial openings but the picture was practically unchanged. Dr. Branauer again managing intrapharyngeal ether anesthesia. I made a long incision about the eighth rib into the pleural cavity, spreading the ribs with wide retractors. The exposure was perfect. The upper pulmonary lobes were apparently normal, of the usual yellowish-pink color of a child's lungs. The lower lobe, however, was liver color and of a firm consistency. The piece of implanted fat was in position and apparently alive. There were dense adhesions of the lower lobe to the diaphragm and to the lateral costal pleura. All adhesions were quickly and rather roughly freed digitally so that it was possible to place a strong double ligature of chromicized catgut completely around the hilum of the lower lobe after having crushed the part with a power clamp. The lobe was then cut away. A slight oozing from the stump led me to transfix once more and to ligate again double. The stump was then carbolized, salt solution was placed within the thoracic cavity, a piece of gauze was laid against the raw surface of the stump and led out of the posterior angle of the wound and another little piece of gauze was placed in the original sinus. The ribs were then approximated with chromicized catgut by the pericostal method. A continuous suture of fine chromicized gut was used to hold the intercostal structure together and the cutaneous incision was sutured with fine silk. At the end of the operation the patient's pulse was about 150 but of good quality. The color, which had been slightly cyanotic during the greater part of the operation, became normal. Reaction was prompt and in less than an hour after the operation the boy was wide awake and crying. The hemorrhage had not been severe, most of it coming from the peeling away of the adhesions.

A careful examination of the lobe which had been removed showed that all the bronchi were dilated and turned into what

might be called abscess cavities. There was no trace of a foreign body.

The first twenty-four hours after the operation the temperature did not rise higher than 101°. The patient's condition was good, pulse about 140, very little cough, no expectoration. Then there was a rise in temperature to 103°, the pulse reaching the alarming rate of 200. The wound was at once dressed, a little superficial suppuration found, and all skin sutures removed. The gauze at the posterior angle of the wound was loosened and there was a discharge of turbid fluid, probably a mixture of salt solution and pus. A tube was slipped in alongside the gauze and full stimulation was ordered. The hemoglobin a few days after operation was, to my surprise, 75 per cent., though the little patient looked very anemic. Very gradually there was improvement, for two weeks, the child being in a serious condition, the pulse causing especial anxiety on account of its great rapidity.

About a week after the operation mechanical suction apparatus was fitted to the tube within the wound and this avoided frequent change of dressing. The patient's appetite remained good throughout.

On March 16, the slough representing the stump of the lung came away.

After this there was steady improvement and the patient, at the present writing, six weeks after the lung resection, is in a satisfactory state of convalescence. A very small opening in the chest is still present but the outlook is most favorable.

Note. This case demonstrates that bronchiectasis originally caused by foreign body aspiration may persist in an apparently incurable state after the removal of the exciting cause.

The amount of fat put in at the time of the Tuffier's lipotamponade, in view of the later findings, was absurdly small. But judging by the appearance and size of the bronchiectasis as seen after the resection I doubt that enough fat could have been transplanted to cure the patient.

The cause of the tachycardia is somewhat obscure. Whether it was a septic phenomenon or whether, perhaps, it had to do with the changed pulmonary circulation, it would be hard to say. Dr.

Koplik, who saw the case in consultation, advised us to give digitalis and under this drug the pulse rate was certainly favorably influenced.

CASE XIV (Unfinished).—*Bronchiectasis; thoracotomy, and drainage.* Louis G., aged thirty-three years, was admitted to Mt. Sinai Hospital on February 26, 1914. He had been a patient of Dr. Mannheimer.

Four years before he had pneumonia followed by empyema for which he had been operated upon. For three years he remained well, then began to cough and expectorate large quantities of mucopurulent material. There were occasional marked hemoptyses. The daily amount of expectoration was eight ounces. The patient was altogether miserable and unable to work. He had lost weight and strength.

On admission, a cicatrix representing the former operation was seen in the posterior axillary line over the ninth rib which apparently had been resected. The general condition of the patient was good. The lungs anteriorly were negative and the right lung was also negative posteriorly. On the left there were signs representing consolidation from the left scapula to the base. There was clubbing of the fingers.

An *x*-ray picture showed an infiltration of the left base with what seemed to be a pulling of the cardiac apex to the left by adhesions.

About March 5 the patient was bronchoscoped by Dr. Yankauer. This bronchoscopy was rather unsatisfactory, owing to the extremely poor anesthesia and the rigidity of the patient's neck which made it difficult to introduce the instrument. Dr. Yankauer failed to demonstrate a bronchiectasis but thought that he saw granulation tissue in the bronchial walls.

On March 11, 1914, in intratracheal ether anesthesia, I incised one space above the old cicatrix and to my chagrin passed through the diaphragm and into the abdomen. The peritoneal opening was at once sutured and the chest entered in the seventh interspace with wide resection of the seventh and eighth ribs. There was a mass of pleuritic adhesions, the lung also being adherent to the chest wall so that twice it was injured and had to

be sutured. A needle puncture now permitted the aspiration of a few drops of foul, thick pus and in the posterior part of the wound near the angle of the rib I opened into the new empty bronchiectatic sponge. The cavity, about 50 c.c. in bulk, was packed with gauze and part of the cutaneous wound closed with drainage. Considerable distress followed the operation, with cough, temperature 103°, and bloody expectoration.

To-day, April 10, the patient's condition is improved and the wound is healing rapidly. He still expectorates from one to two ounces daily and his complete cure without further operation is doubtful.

CONCLUSIONS BASED ON OBSERVATIONS IN THE CASES RECORDED

1. The differential diagnosis of true lung abscess and suppurative bronchiectasis is important.

2. Radiographic study of each case is essential.

3. Bronchoscopic examination is a valuable procedure, and should not be omitted.

4. Drainage of a lung abscess by thoracotomy is likely to result in cure.

5. Drainage of large infected bronchiectases may be followed by improvement, but complete recovery is unlikely.

6. Extensive thoracoplasty should be reserved for those cases in which other operations have failed.

7. Exploration of the pleural cavity and of the lungs by intercostal thoracotomy is feasible and reasonably safe.

8. Extirpation of a bronchiectasis by removal of the affected portion of lung may lead to complete recovery. The danger of the operation is great.

9. Artificial pneumothorax and Tuffier's extrapleural tamponade should be reserved for cases of pure tuberculosis.

10. Intratracheal insufflation is a simple, accurate, and safe method of securing differential pressure.

11. Operations involving one lung can be performed with inhalation anesthesia.

TABLE OF CASES RECORDED.

Case No.	Name.	Age.	Sex.	Date.	Disease.	Type of operation.	Anesthesia.	Post-operative days in hospital.	Immediate result.			Remarks.
									Cured.	Improved.	Died.	
1	B. F.	55	M.	Feb. 21, 1910	Bronchiectasis	Exploration	Intratracheal ether	27	...	1	...	Died one year later of pulmonary hemorrhage.
2	I. B.	19	M.	Aug. 17, 1911	Bronchiectasis	Thoracoplasty	Inhalation ether	42	...	1		
2	I. B.	20	M.	Apr. 12, 1912	Bronchiectasis	Thoracoplasty	Insufflation ether	34	...	...	1	Infection of the other lung.
3	G. R.	30	M.	Feb. 16, 1912	Bronchiectasis	Thoracoplasty	Insufflation ether	32	...	1		
4	H. G.	23	M.	Dec. 20, 1912	Bronchiectasis	Thoracoplasty and drainage	Insufflation ether	60	...	1	...	Opening into bronchiectasis closed spontaneously.
4	H. G.	24	M.	Nov. 21, 1913	Bronchiectasis	Large thoracoplasty (posterior)	Inhalation ether	90?	...	1	...	Improvement but condition still unsatisfactory, 3 to 4 ounces of sputum per day.
5	A. S.	26	F.	May 26, 1913	Bronchiectasis with fistula	Free drainage by rib resection	Insufflation ether	90	...	1		
7	H. L.	41	M.	Mar. 29, 1912	Acute abscess	Thoracoplasty and drainage	Insufflation ether	4	...	...	1	
8	E. B.	24	F.	Oct. 12, 1912	Acute abscess	Exploratory thoracotomy	Gas and oxygen by inhalation					
8	E. B.	..	..	Nov. 14, 1912	Acute abscess	Second stage thoracotomy and drainage	Nitrous oxide inhalation	62	1	...	...	Patient remains well to date.
9	N. S.	22	M.	Dec. 23, 1912	Acute abscess	Thoracotomy and drainage	Nitrous oxide and oxygen	120	1	...	...	Patient well to date.
6	H. A.	48	M.	Oct. 11, 1913	Pulmonary gangrene	Thoracotomy and drainage	Local	4	...	...	1	Hopeless from the beginning.
11	V. H.	12	M.	Jan. 12, 1913	Chronic abscess of apex	Thoracotomy and drainage	Ether inhalation	88	1	...	...	Through drainage, supraspinous region to front of chest.
12	J. P.	42	M.	Nov. 7, 1913	Fetid bronchitis	Extrapleural tamponade (Tuffier)	Insufflation ether	21	...	..	1	Case mistaken for bronchiectasis.

SURGICAL INTERVENTION IN CASES OF PULMONARY INFECTIONS

By PROFESSOR ANTOINE DEPAGE
PARIS

You have, all of you, observed the results of Forlanini's method for lung tuberculosis. They are most favorable in cases where one lung only is affected, and where there are no pleural adhesions. Forlanini's treatment is rather medical than surgical. We are pleased to say that this medical treatment is based on a surgical principle.

It is admitted that artificial pneumothorax as created through this method acts as follows:

1. In allowing the affected organ to rest, while the movement of normal respiration would prevent healing.

2. In allowing the walls of the cavities to fall together, thus emptying themselves of pus. It diminishes the absorption of toxins and the increase of bacteria. It allows a better healing of the ulcerated surfaces, on account of their proximity.

3. It is favorable to sclerosis of the pulmonary organs because it diminishes the blood and lymphatic circulation and produces irritation by the introduction of nitrogen in the pleura. (Castaigne.)

I have been wondering if perhaps there would not be reasons to make wider applications of Forlanini's method, which would not be limited to tuberculosis. This question was brought to my notice by the following case:

In 1900, I had a case of infectious pneumonia, which seemed as though it would be fatal on account of intoxication. What

had to be done? The patient was a healthy woman of twenty-seven years; one lung only was affected, the right one—temperature 39.3 centigrade.

You will follow, without my having to tell you, the reasons which brought me to resect two ribs, and to open widely the right pleura. Relief came rapidly, the temperature fell, toxic symptoms disappeared; the patient recovered.

The question I am asking you is quite simple, and you will answer it yourselves.

What are the indications for such an intervention?

Unilateral pneumonia may cause death by acute intoxication before there would be time for the second lung to become inflamed, so to say. At this moment I would not propose to resect the ribs, as I did in the case above, but I believe that Forlanini's method would be indicated. The collapsed lung is put at rest; it is no longer disturbed by respiratory movements; its circulation is far less active than when the lung is in normal inspiration.

A collapsed lung can be compared to a member lightly compressed by a bandage, and this without allowing the intra-pleural pressure to be greater than the atmospheric pressure, simply by the fact of elastic retraction of the organ.

In suppressing the respiratory movements and in diminishing the quantity of blood circulating through the organism, the chances of absorption of toxins which are the causes of immediate danger are reduced.

A REPORT OF THE CASES OF LUNG ABSCESS AT THE MASSACHUSETTS GENERAL HOSPITAL CLINIC

By CHARLES L. SCUDDER, M.D.
BOSTON

In the year 1906 Dr. Frederick T. Lord, now a visiting physician to the Massachusetts General Hospital, in Boston, published a paper upon "Abscess of the Lung Based upon a Study of the Cases Operated upon at the Massachusetts General Hospital." He reported 6 cases of an acute type and 5 cases of a chronic type, a total of 11 cases, with 4 deaths, 2 cases relieved with a sinus, 1 case relieved without a sinus, and 4 cases cured four years, five years, eight years, and twelve years following operation (See Tables I and II).

In view of the very great interest in the surgery of the lung today it occurred to me that a report from this same clinic of the cases of abscess of the lung operated upon since 1906 might be of some interest and value. I, therefore, in this paper report the details of 16 cases of lung abscess treated by operation.

All of these cases have been observed by the medical service at the hospital, as well as by the roentgenological and bacteriological departments.

I suppose that very few cases of diseases of the lung have been more thoroughly and painstakingly studied in this clinic than those recorded in the present series. There was a total of 16 cases; 14 of these abscesses were in men, 2 were in women. The ages extended from seventeen years to fifty-four years; 14 of the operations were done in two stages, 2 of the operations

were done in one stage. Ether was employed in all cases as the anesthetic. There were 5 deaths in the series; 3 of the cases thus far followed were unimproved, and 8 have been at least relieved, and some permanently cured.

The variety of etiological factors which may be present in abscess of the lung is well illustrated in this series of cases. The largest number was caused by the influenza bacillus associated with a bronchopneumonia. There were several embolic cases, several cases of subdiaphragmatic origin, and 1 case of actinomycosis.

The following facts seem to me apparent from a study of this group:

1. The bronchiectatic process should be attacked by the surgeon while it is limited to one lobe of a lung. A very decided attempt should be made to determine as early as possible the diagnosis of bronchiectasis. Surgery may be able then by the excision of a single lobe to cure such a condition.

2. There was one case of actinomycosis in which the diagnosis was made by Dr. William H. Smith in conjunction with Dr. James H. Wright after painstaking study. This case of actinomycosis was cured by surgical operation. It suggests that actinomycosis of the lung must be recognized in its initial stage and vigorously attacked by surgery, for only in this way is there a great likelihood of curing this very fatal disease.

3. Attention is attracted to lung abscess following tonsillectomy. There have been several in my experience. There is one case in this series which followed operation upon the nasal septum. The inhalation of foreign material may have been the starting-point in this case. The employment of intratracheal anesthesia with gauze-packing of the pharynx may be wise in these cases.

4. From certain cases in this series it is suggested that the surgeon should be alert to the occurrence of lung abscess associated with embolism following surgical operations. A patient suddenly suffering severe pain in the chest following surgical operation associated with a rise in temperature and pulmonary

signs should be very carefully studied lest such signs may mean the beginning of pulmonary abscess. Early operative interference upon the lung in such cases may not only preclude the possibility of the extension of a pulmonary lesion but may save the life of the individual.

5. An increasing number of intra-abdominal infections are associated directly with an infection through the diaphragm of the diaphragmatic pleura, and then of the lung with pulmonary abscess. These cases of subdiaphragmatic origin must be attacked early to prevent subsequent damage intrathoracically.

6. The *x*-ray is of great value in the diagnosis of lung abscess. The thorough roentgenological examination necessitates fluoroscopic observations, stereoscopic plates, and both anterior and posterior views. If there is reason to suspect fluid in the chest the examination should be made in the upright as well as in the horizontal position. The exact position of the heart, the position and excursion of the diaphragm, and the clearness of the costodiaphragmatic angle are facts which help in the interpretation of the *x*-ray plates.

The recognition of the presence or absence of tuberculosis, of a diffuse bronchiectasis, of syphilis of the lung, will all assist in the interpretation of the plates. Centrally seated abscesses, almost impossible of determination by ordinary physical signs, may be accurately localized by the *x*-ray.

The *x*-ray is of assistance in the interpretation of physical signs in cases of suspected lung abscess and bronchiectasis, and may be of assistance in the exact localization of the abscess.

7. Finally, I believe that this total series of twenty-seven cases demonstrates the efficacy of surgical measures in the treatment of abscess of the lung. There were nine deaths, 18 recoveries, and 11 cases were practically well without cough or sputum.

Certain details of the histories of the cases of abscess of the lung in this series, together with the tables based upon them, are as follows:

TABLE I.—ABSCESS OF LUNG. ACUTE CASES PREVIOUS TO 1906.
(Reported by Dr. Frederick T. Lord from the Massachusetts General Hospital Clinic.)

Name.	Cause.	Duration.	Seat.	Operation.	Surgeon.	Result. Immediate.	Result. Remote.
J. R.	Pneumonia	3 wks.	R. M. L. (?)	Cavity 4 in. into lung; Oiss pus removed	..	R.	Relieved with sinus.
O. A.	?	2 mos.	R. L. L.	Connects with bronchus; evacuation of Oiss very foul pus	..	R.	Well—12 years.
M. D.	Trauma; exposure in water	2 mos.	R. L. L.	Cavity size of a walnut	..	R.	Much relieved with sinus.
P. S.	Pneumonia (I) Empyema (II)	14 mos.	L. L. L.	Gangrenous lung connected with bronchus	..	R.	Well—5 years.
T. C.	?	6 wks.	R. L. L.	Multiple lung abscesses; evacuation of abscesses	..	D.	Autopsy: Multiple abscesses; empyema.
K. F.	Empyema through bronchus	2 mos.	L. L. L.	Connects with bronchus; evacuation of empyema	..	R.	Well—4 years.

TABLE II.—ABSCESS OF LUNG. CHRONIC CASES PREVIOUS TO 1906.
(Reported by Dr. Frederick T. Lord from the Massachusetts General Hospital Clinic.)

Name.	Cause.	Duration.	Seat.	Operation.	Surgeon.	Result. Immediate.	Result. Remote.
F. D.	Pneumonia	4 yrs.	R. L. L.	Lung honeycombed	..	D.	No relief.
C. C. B.	Pneumonia	17 mos.	L. L. L.	Single abscess of lung; ℥iv pus evacuated	..	R.	Remained with pulmonary symptoms, 8 years.
H. B.	Pneumonia	9 mos.	R. L. L.	Multiple abscesses of lung; three operations	..	R.	Slightly relieved at each operation.
E. M.	Insidious onset	11 mos.	L. L. L.	Multiple abscesses of lung; evacuation of abscesses	..	D.	Autopsy: Multiple abscesses; chronic interstitial pneumonia; bronchiectasis.
R. D.	Insidious onset	18 mos.	R. L. L.	Abscess of lung? Gangrene of lung? Evacuation of ℥ij pus	..	D.	Death soon after leaving hospital.

TABLE III.—CASES OF ABSCESS OF LUNG SINCE 1906.
(Reported by Dr. C. L. Scudder from the Massachusetts General Hospital Clinic.)

No.	Cause.	Duration.	Seat.	Operation.	Surgeon	Result. Immediate.	Result. Remote.
1	Pneumonia	8 days	Rt. base	1 stage	C. L. S.	D.	Abscesses of liver and lungs.
2	Post-operative	3 wks.	Rt. base	2 stages	W. W.	R.	Cured—6 months.
3	Pleurisy	1 mo.	Lt. base	2 stages	S. R.	R.	Left hospital in good condition.
4	Duodenal ulcer	1 mo.	Rt. base	1 stage	C. L. S.	R.	Local empyema (through bronchus).
5	Actino-mycosis	7 wks.	Lt. base	2 stages	C. L. S.	R.	Left hospital in good condition.
6	Pneumonia	2 mos.	Lt. base	2 stages	F. C. C. C. S.	D.	No relief at any time.
7	Pneumonia	2 mos.	Rt. base	2 stages	C. L. S.	D.	Postoperative empyema; septicemia.
8	Pneumonia	4 mos.	Rt. base and liver	3 operations	F. C. F. B. H.	D.	Abscesses of lung, liver, and brain.
9	Unknown	6 mos.	Lt. base	2 stages	C. A. P.	R.	Unimproved.
10	Pleurisy	9 mos.	Rt. base	3 operations	C. L. S.	D.	Abscess of lung; mucous colitis.
11	Pneumonia	11 mos.	Lt. base	2 stages	W. W.	R.	Cured—1 year.
12	Unknown	1 yr.	Rt. apex	2 stages	C. L. S.	R.	Left hospital in good condition.
13	Pneumonia	1 yr.	Lt. base	2 stages	S. R.	R.	Cured—1 year.
14	Pleurisy	3 yrs.	Lt. base	2 stages	C. L. S.	R.	Left hospital slightly relieved.
15	Duodenal ulcer	4 yrs.	Rt. base	2 stages	C. L. S.	R.	Cured—6 months.
16	Pneumonia	6 yrs.	Lt. base	2 stages	C. L. S.	R.	Unimproved.

CASE I.—M. M., male, aged thirty-eight years, entered the Massachusetts General Hospital on February 6, 1908. The patient was suffering from an attack of pneumonia of the right base. On February 27 he was transferred to the surgical service. There was a history of chills in the evening and vomiting in the morning for eight days. There was little expectoration. The sputum was tenacious, brownish, and purulent.

Examination found a slight dulness at the right base, no

bronchial breathing, and diminished respiration and fremitus. The heart action was not strong. The patient had erysipelas of the face. The *x*-ray showed a circumscribed shadow behind the scapula on the right side between the fifth and ninth ribs. Bacteriological examination showed many pneumococci and streptococci in an abundant sputum, brownish in color, tenacious, and purulent.

An exploratory puncture was done by Dr. C. L. Scudder on February 16, 1908, and solid lung found. March 2, 1908, under cocain, a costectomy was done and a pus cavity the size of a fist was drained.

The patient improved the first nineteen days after the operation but following this he had chills and rise of temperature, and died on the twenty-fourth day. At the autopsy multiple abscesses of the lungs were found, multiple abscesses of the liver, purulent infiltration of pleural adhesions on the right, a soft spleen, and acute degeneration of myocardium and kidneys.

CASE II.[1]—J. D. C., boy aged seventeen years, entered the Massachusetts General Hospital on August 20, 1913. There was a history of frontal headache for three weeks and a foul odor to the breath for two weeks. One week previous to entrance he began to cough with foul pus-like sputum. There was slight pain under the right scapula. July 23, 1913, one week previous to the onset of any symptoms, an operation for deviated septum had been done. July 27 the chest symptoms began. August 1, 1913, he first complained of pain in the chest and coughed up yellow sputum.

Examination, August 20, found the right chest fixed, generally tympanitic, with fulness high up in the region of the second and third ribs anteriorly. The *x*-ray showed an abscess of the right lung. There was dulness as low as the fourth rib in front.

August 21, 1913, Dr. Wyman Whittemore resected the fourth, fifth, and sixth ribs, and on August 26, incised and drained an abscess of the right lung.

[1] Boston Medical and Surgical Journal, March 12, 1914.

The patient was much improved by the operation. There was very little discharge connected with the abscess when he left the hospital on September 20, 1913.

January 7, 1914, the patient was reported perfectly well excepting for some shortness of breath.

Case III.—A. M., male, aged nineteen years, entered the Massachusetts General Hospital on November 9, 1909. There was a history of a sudden onset of pain in the left lower chest five weeks previously. One week later the patient began to cough, raising a foul smelling sputum. He had no chills, but there was a loss of appetite and strength. The abdomen was negative.

Examination found a triangular area of dulness over the left lung at the right spine of the scapula. The left apex and upper half sounds were diminished. Bacteriological examination of the sputum found many cocci and bacilli present though a small Gram positive bacillus was predominant.

On November 8, 1909, aspiration of the left lower back discovered thick pus. On November 10, 1909, Dr. Samuel Robinson did a thoracotomy with drainage of the lung abscess.

The patient made a rapid and satisfactory recovery. The wound healed well and the patient was discharged from the Hospital on December 2, 1909, with no cough.

There has been no subsequent report from this patient.

Case IV.—W. McE., male, aged forty-five years, entered the Massachusetts General Hospital on February 25, 1914. In February, 1913, an appendectomy was done. The man had symptoms of a general peritonitis and it was thought to be a perforated appendix. The appendix appeared normal, and a perforated duodenal ulcer was suspected, but owing to the poor condition of the patient no other operation was then done.

In August, 1913, a posterior gastro-enterostomy was done because of the symptoms of duodenal ulcer. Following this operation an abdominal sinus developed in the upper end of the median laparotomy wound. In September, 1913, an exploratory laparotomy was done to determine the cause of the abdominal

sinus. No cause was determined and the sinus persisted. In January, 1914, associated with abdominal pain and vomiting, symptoms of rupture of a subdiaphragmatic abscess into the lung appeared, and from that date the patient coughed up much sputum. Signs of an empyema and lung abscess appeared in the right chest. The culture from the sputum and from the abdominal sinus showed similar organisms.

In February, 1914, the seventh and eighth ribs were removed on the right side and an empyema cavity was disclosed localized about the size of an orange. This cavity communicated with the abdominal sinus and with the lung. The cavity was drained, the abdominal sinus was curetted, and today the sinus has healed. There is a slight discharge from the yet unobliterated empyema cavity. The man has no cough and raises no sputum.

Case V.—J. J. M., male, aged thirty-nine years, entered the Massachusetts General Hospital on May 2, 1913. There was a history of a sudden onset of cough, with pain in left lower axilla, seven weeks previously. The sputum was yellow and tenacious. He had occasional night sweats.

Examination found a questionable dulness in the left lower axilla with many rales. The *x*-ray showed a lung abscess with involvement of pleura. Actinomycosis colonies were found in the sputum, and also many pneumococci.

On May 5, 1913, Dr. C. L. Scudder resected the seventh, eighth, ninth, and tenth ribs. On May 12, 1913, Dr. Scudder incised and drained the abscess of the lung for actinomycosis.

The patient was discharged May 31, 1913, much improved by the operation.

This patient is now well.

Case VI.—W. I. G., male, aged twenty-six years, entered the Massachusetts General Hospital on August 26, 1908. There was a history of pneumonia two months previously and a purulent sputum ever since. The patient complained of being tired and weak. He could not sleep on account of his cough.

Examination found dulness over the left lung extending downward from the fourth rib in front around to the posterior

axillary line. Bacteriological examination of the sputum showed a variety of bacteria, especially pneumococci. There were staphylococci and streptococci. No tubercle bacilli.

On August 28, 1908, a costectomy with drainage of abscess of left lung with a walled-off cavity was done by Dr. Farrar Cobb. On September 17 a secondary costectomy with drainage was done by Dr. C. C. Simmons.

Pyrexia continued after the first examination, and there was no improvement at any time. The patient died September 28, 1908, eleven days after the second operation. There was no autopsy.

Case VII.—H. N. M., male, aged thirty-nine years, entered the Massachusetts General Hospital on November 5, 1912. There was a history of frequent sore throats for years. Nine weeks previous to his entrance to the hospital an operation had been done for the removal of his tonsils, with considerable loss of blood, after which he began to cough and raise large amounts of sputum. This attack had persisted. He was troubled with dyspnea and some orthopnea.

Examination found slight dulness throughout the right chest behind and dulness to flatness at the base. The *x*-ray showed a dense shadow at the right base. The diaphragm was not seen on the right. Bacteriological examination of sputum showed numerous influenza bacilli, some Gram positive and small diplococci and some staphylococci, a few pneumococci and an occasional streptococci. The sputum was mucopurulent, tenacious, and frothy white.

On November 7, 1912, Dr. C. L. Scudder made an incision and drained the right pleural cavity. There was some bloody fluid but no pus. On November 21, 1912, Dr. Scudder resected the rib and opened an abscess in the right lung.

Following the operation there was considerable drainage from the wound and but slight improvement in the condition of the patient. December 10, 1912, an *x*-ray showed post-operative empyema. The patient died December 28, 1912.

The autopsy showed bronchiectasis with abscess of right

lung, chronic pneumonitis of right lung, left empyema, compression atelectasis of left lung, chronic pleuritis, soft hyperplastic spleen, and streptococcus septicemia.

Case VIII.—J. J. F., male, aged twenty-two years, entered the Massachusetts General Hospital on August 22, 1908. Four months previously he had been operated upon at the Boston City Hospital for an "abscess of the liver." He contracted pneumonia following the operation and was troubled with hemoptysis from that time and for which he came to the Massachusetts General Hospital to be treated. Examination showed dulness over the base of the right lung from the third to sixth rib. The patient was emaciated. An aspirating needle discovered thick yellow pus at the anterior axillary line in the fifth space. Bacteriological examination of the sputum showed some diplococci which resembled pneumococci. There was no tubercle bacilli.

On August 24, 1908, Dr. Farrar Cobb did a resection of the rib with drainage of the abscess of the right lung. On October 9, 1908, it became necessary to do a secondary resection of the ribs with a drainage of hepatic and pulmonary abscesses. Dr. F. B. Harrington performed the operation. On November 9, 1908, Dr. Harrington again resected the ribs and drained an abscess of the lung. Following this operation the patient became erratic and violent, causing several hemorrhages from the wound. An *x*-ray showed a shadow still in the upper part of the right lung. The patient died December 19, 1908.

The autopsy showed an abscess of the liver, chronic perihepatitis, slight acute peritonitis, a partially evacuated abscess cavity of the right lung, a thrombus of the right iliac and femoral veins, abscesses of the brain, and streptococcus septicemia.

Case IX.—D. A. C., male, aged thirty-one years, entered the Massachusetts General Hospital on April 26, 1909. There was a history of a sudden onset of violent coughing with a little foul sputum six months previously. The patient remained in bed for three weeks, raising large amounts of foul sputum, when he became somewhat improved. For the four weeks before

his entrance to the hospital he had been in bed with a recurrence of the former symptoms.

Examination found dulness to flatness on the left below the fifth rib in front and below the spine of the scapula in back. The abdomen was negative. The patient complained of pain in the left upper chest.

April 27, 1909, Dr. C. A. Porter resected the eighth and ninth ribs. On May 1, 1909, an exploration and drainage of the abscess cavity of the left lung was done.

The patient made a slow but steady improvement and the wound closed June 26. When discharged from the hospital on July 6, 1909, the patient was still coughing up considerable amounts of sputum.

On April 16, 1910, a second operation upon the lung was done at Ogdensburg, New York. The patient reported on July 20, 1910, that there was no improvement. The wound was discharging freely and he still wore a tube.

Case X.—S. D., female, aged thirty-six years, entered the Massachusetts General Hospital on October 18, 1913. There was a history of pain in the right side and chills nine months before entrance. The pain persisted and three months later she began to cough and raise foul sputum. She had just recovered from an attack of trifacial neuralgia.

Examination found an area of flatness over the lower right lung. The *x*-ray confirmed the diagnosis of lung abscess. Bacterial examination of the sputum showed Gram positive cocci, some large and round, others resembling pneumococci. There were no tubercle bacilli. The sputum was profuse and mucopurulent.

On October 18, 1913, Dr. C. L. Scudder resected the ninth and tenth ribs preliminary to thoracotomy with drainage of abscess of the right lung on October 24, 1913. November 25, 1913, an exploration of the abscess for insufficient drainage was done.

The patient was troubled with diarrhea, and ulcerations of tongue. There was a gradual loss of strength, probably due to the persistent mucous colitis. She died February 5, 1914.

There was no autopsy in this case. The diagnosis was abscess of the right lung, mucous colitis, and inanition.

CASE XI.[1]—F. S. A., female, aged twenty-one years, entered the Massachusetts General Hospital in September, 1912. There was a history of cough and pain in the left chest, with thick dark brown sputum following ether for the removal of fifteen teeth eleven months previous to entrance. The cough persisted and became worse in January, 1912. In March and April, 1912, she had two hemorrhages. For the last two weeks she had been troubled with pain and dyspnea.

Examination found the whole right back slightly dull. The left back was slightly tympanitic, with a flat area with absent breath sounds. The *x*-ray showed a dense shadow occupying the whole left middle chest. The right lung was negative. Bacteriological examination of the sputum showed many bacteria, mainly cocci of various kinds, none of which predominated. There were no tubercle bacilli or influenza bacilli seen. Later an examination found a very rare elastic fiber present.

September 27, 1912, Dr. Wyman Whittemore resected the third, fourth and fifth ribs on the left, with drainage of the abscess. On October 17, 1912, Dr. Whittemore resected the eighth rib with drainage of a left empyema.

The patient made a rapid gain after the second operation. She was sent home in good condition on November 4, 1912.

November 17, 1913, one year later, the patient reported that she had no cough. During the spring she had caught cold and begun to cough, but had been cured by vaccine treatment by her local physician. She considers herself entirely well.

CASE XII.—A. D'O., male, aged forty-three years, entered the Massachusetts General Hospital on February 24, 1909. Through an interpreter there was a history of good health up to one year previously, when the patient began to cough. The sputum was whitish. January 7, about one month before entrance, he had an attack of hemoptysis, and since then his sputum had been foul and bloody.

[1] Boston Medical and Surgical Journal, March 12, 1914.

Examination found a slight dulness on the right chest above and just below the clavicle. The voice sounds were increased. The patient's breath was very foul. The *x*-ray showed a distinct shadow beneath the right clavicle. Bacteriological examination of the sputum found repeatedly no distinctive bacteria. No elastic fibers were seen and no tubercle bacilli. The sputum was a foul red fluid with tenacious red-yellow froth.

On February 25, 1909, Dr. C. L. Scudder resected the second and third ribs on the right side and sutured the lung to the pleura. On March 4 the lung was incised and the abscess drained. On March 31 a resuture of the skin flap was done.

The patient made a rapid gain in strength following the second operation. The discharge from the wound constantly diminished, and the patient was sent home April 2, 1909, in excellent condition. April 2, 1910, a letter sent to this patient's address was returned unclaimed.

Case XIII.—G. S. E., male, aged twenty-one years, entered the Massachusetts General Hospital on January 4, 1911. There was a history of an attack of pneumonia one year previously, following which the patient was troubled with a cough and sputum for two months. He improved during the summer, but in September, 1910, became worse again and the cough persisted up to the present entrance. The patient complained of pain on deep breathing, night sweats, and weakness.

Examination found dulness in the left lung from the apex to just below the angle of the scapula in the back. The *x*-ray showed a dense shadow in the left midchest and a less dense shadow throughout the whole left lung. Bacteriological examination of the sputum showed a growth of unevenly Gram staining, branching anërobic actinomycotic-like organisms, a few streptococci and small decolorizing bacilli. A previous examination of the sputum found pneumococci predominating.

January 5, 1911, Dr. Samuel Robinson resected the sixth and seventh ribs and drained the abscess. Convalescence was interrupted by a hemorrhage from the wound on Jaunary 26. There was a rapid gain afterward.

On February 20, 1911, there was a second hemorrhage from the wound. February 25, 1911, Dr. Robinson resected the sixth and seventh ribs and made a closure of bronchus and vein for hemorrhage. The patient made a steady improvement after the second operation.

On March 20, 1912, the patient reported that the chest wound had practically healed. There was no discharge. Resonance and breath sounds were good.

Case XIV.—F. L. McL., male, aged thirty-five years, entered the Massachusetts General Hospital on April 24, 1913. There was a history of a cold and pain in the left axilla three years ago. Since then a cough had persisted, and the sputum had been foul and large in amount. He had occasional chills and night sweats. He slept poorly but gained in weight.

Examination found dulness throughout the left lung on the back and numerous fine moist rales. The *x*-ray showed a chronic process at the left base involving the pleura. Bacteriological examination found swarms of influenza bacilli. There was an average of ten ounces of sputum daily.

April 28, 1913, Dr. C. L. Scudder resected the eighth, ninth, and tenth ribs as a preliminary operation. May 2, 1913, Dr. Scudder incised and drained the abscess of the left lung.

The patient made a slow but steady recovery. He was discharged from the hospital on May 29, 1913, with cough persisting.

There has been no subsequent report from this patient.

Case XV.—C. Z., male, aged fifty-four years, entered the Massachusetts General Hospital on September 4, 1913. There was a history of a winter cough, with considerable sputum for eight or nine years. Four years previously a posterior gastroenterostomy was done for a duodenal ulcer. Following the operation the patient had fever and a cough. The cough had persisted for four years. Four or five days previous to entrance to the hospital his cough became worse and the sputum became foul and increased in quantity.

Examination found an area of dulness at the right base.

The *x*-ray showed a question of a liver abscess and a question of a lung abscess. Bacteriological examination of the sputum showed many organisms, none of which predominated. There were Gram-positive and Gram-negative cocci, diplococci, and bacilli. There was no elastic tissue and no tubercle bacilli.

On September 5, 1913, Dr. C. L. Scudder resected ribs and sutured the lung to the pleura, and on September 10 incised and drained the abscess cavity of thick necrotic material.

The patient made a good convalescence. There was a small sinus in the wound when he left the hospital on September 30, 1913.

The patient was reported well in March, 1914, and at work.

Case XVI.—J. J. W., male, aged twenty-four years, entered the Massachusetts General Hospital on May 11, 1907. There was a history of acute exacerbation of bronchiectasis in March, 1904, following pneumonia in 1901. In February, 1904, Dr. Eliot had operated in two stages for an abscess of the left lung. Since that time the patient has had five or six acute attacks, the last attack beginning one week previous to the present entrance to the hospital.

Examination found dulness in left lung below the angle of the scapula and the fifth rib in front and over an area two inches square over the ninth rib in back. The *x*-ray showed a shadow in the left base, in the midaxillary line at about the eighth rib. Bacteriological examination of the sputum showed a profuse growth of streptococci. There were a few influenza bacilli and a few pneumococci, besides many other bacteria.

A preliminary costectomy with suture of the left lung and pleura was done by Dr. C. L. Scudder on April 16, 1907. On May 17, 1907, an exploration of the lung was made, but no cavity suggesting an abscess was found.

The patient made a good convalescence from the operation, and was discharged from the hospital on May 24, 1907. On October 28, 1910, the patient reported that his general health was very good, but the condition of his lung was unchanged. He raised as much pus as ever.

RESULTS AND PROSPECTS OF SURGICAL TREATMENT OF TUBERCULOSIS OF THE LUNGS AND OF BRONCHIECTASIS

By CHARLES HENSCHEN, M.D.

When your honored president requested my chief, Prof. Sauerbruch, to deliver a lecture before your meeting for this year, the Zurich Clinic naturally regarded compliance with this complimentary request obligatory. They felt this the more keenly, since you chose your main theme from a field with which the Zurich Clinic is intimately and particularly connected. You will understand, therefore, why I, in fulfilment of this duty, wished to contribute precisely to your particular topic, the discoveries of the Sauerbruch Clinic. It seemed to me most advantageous to point out the differences in the results of our modern indirect operations on the lungs at the opposite poles of inflammatory lung diseases, from the anatomical and the clinical point of view, using tuberculosis of the lungs as main representative of diseases of the lung parenchyma, and bronchiectasis as the paramount example of surgical diseases of the respiratory system. The present state of our experience has made it possible to establish definite principles for the different methods of operation in diseases of the parenchyma and in those of the bronchial tree of the lungs. Thereupon we may outline the paths by which these efforts may be further developed with hope of success.

I. The Surgical Treatment of Pulmonary Tuberculosis. In the surgical treatment of tuberculosis of the lungs,

direct operations upon the substance of the lungs are reserved for the rarest and most exceptional cases, making way for the more common use of indirect, extrapulmonary methods. The reason for this change in procedure is the recognition of the fact that even unilateral pulmonary tuberculosis in an advanced and apparently desperate condition, can be cured, as soon as the most efficacious mechanical and biological conditions for anatomic cure have been locally created.

The most serious obstacle to a cure in the infiltration forms of tuberculosis of the lungs as well as in those with cavities, proved to be the participation of the diseased organ in respiration. The physiological and mechanical dependence of the lungs upon the surrounding bony framework and its muscular motor system, keeps the diseased as well as the sound part occupied in the rhythmic process of respiration. Therefore, even when a tendency to shrinking is present, a collapse, and consequently, an obliteration of tubercular cavities is mechanically made impossible. For this same reason, the infection is carried to hitherto unaffected parts through aspiration or by the lymph passage. These unfavorable, even detrimental mechanical conditions further cause deterioration in regard to the circulation of the organ, check the essential growth of connective tissue in the rigidly extended lungs, in which tubercular granulation must be replaced through sound cicatricial tissue. At the same time the lack of connective tissue in the affected parts increases their susceptibility to bacteria, through which, indirectly, the progress of the disease and the setting in of degenerative processes are furthered.

These various mechanical obstacles to a cure are at once set aside, as soon as we exclude the organ from the automatic participation in respiration, and, first of all, cause collapse and shrinking in order to pave the way for the formation of connective tissue. The elastic retraction and compression of the pulmonary tissue, evoke uniform and identical reactions in the shrunk organ, whether retraction and compression are conditioned by exudate or transudate, by spontaneous or artificial

pneumothorax or plastic operation on the thorax. The result is always a collapse of the real parenchyma, an atelectasis in those parts of the lungs that are capable of compression and situated at some distance from the bifurcate angles of larger cartilaginous bronchi. The next anatomic result is a considerable development of connective tissue, beginning from the perivascular peribronchial and subpleural regions, which is naturally most marked within the zone of inflammation produced by the tubercular foci. Jehn proved, by means of pathologic-anatomic investigations into the cases of the Zurich Clinic, that these processes in exudate, pneumothoracic, and thoracoplastic lung are uniform, regular, and fixed. By this proliferation of connective tissue throughout the organ the tubercular foci become encapsuled within thick cicatricial walls which form a mechanical impenetrable barrier against tubercular bacilli and their symbiotic secondary bacilli; or it may be that this proliferation directly replaces and organizes the tubercular granulation. Furthermore, a considerable deposit of anthracotic pigment in the lymphatics decreases the permeability of the tissue for bacteria. Finally, the lungs are transformed into a pulpy and firm mass of tissue, which includes bronchi dilated by cicatricial traction, and, at the bifurcations of the latter, remnants of dilated alveoli. At the same time the cavities collapse; the diminution in the formation of the secretion and in its congestion in the now fissure-like purulent cavities, leads by means of a sharp demarcation of the tubercular cavernous membrane to anatomic purification of the wall of the cavity, with ultimate replacement of the tubercular granulation by sound cicatricial tissue.

The biological factors that induce these anatomic processes are not sufficiently well known, either as regards their individual significance, or the manner of their coöperation. The cure represents the sum total of many interacting factors. These are the exclusion of the organ from functioning, its fixation in a state of rest and relaxation, the elastic retraction and the compression, the change in the stream of blood, the congestion

of the lymph, and therewith, of the toxins, processes of auto-immunization, a specific biologic and serologic action of pneumothoracic or peripheral exudates that may be present, the lowering of the bacterial permeability by means of the lymph congestion and the renewed growth of connective tissue, the absence of danger from aspiration, secondary thrombosis in the final ramifications of the pulmonary artery, with subsequent proliferation of the connective tissue in the thrombosed pulmonary region.

The clinical concomitant phenomena of this fibrous transformation, and of the obliteration of the cavities of the collapsed lungs are typical. The therapeutic operation that causes the collapse is immediately followed by an exaggeration of all symptoms, as the first stage; a reactive increase of the daily sputum (emptying of the cavities through pressure), which is the clinical expression of the processes of demarcation, ejection, and purification that take place in the walls of the cavities, and of the gradual emptying of secondary stagnant cavities, but which is also essentially influenced by the increase in all the inflammatory processes, and especially in secretion as a result of the sudden inversion of the mechanical biological conditions. Parallel with this is a reactive increase in temperature, the result of the sudden absorption of the toxin, whereby occasionally, very favorable cases show, at first, exceedingly strong reaction, and causally, closely related with the increase in temperature, an increase in the frequency of the pulse, which in the first days often rises entirely out of proportion with the temperature.

After an interval of varying length, the average being one to three weeks, clinical symptoms of approaching improvement appear; decrease in the sputum which may fall from daily quantities of 200 to 400 c.c. to 0, the rapidity of the decrease being dependent upon the strength of the compression and the rigidity of the cavernous walls; the mucous transformation of the once wholly purulent sputum; decrease and final disappearance of the tubercular bacilli; a fall in the hectic tem-

perature curves which, in rare cases, is sudden, but more generally is gradual; improvement in appearance, appetite, sleep, cessation of previous hemoptysis, disappearance of former tachycardia, and increase in weight.

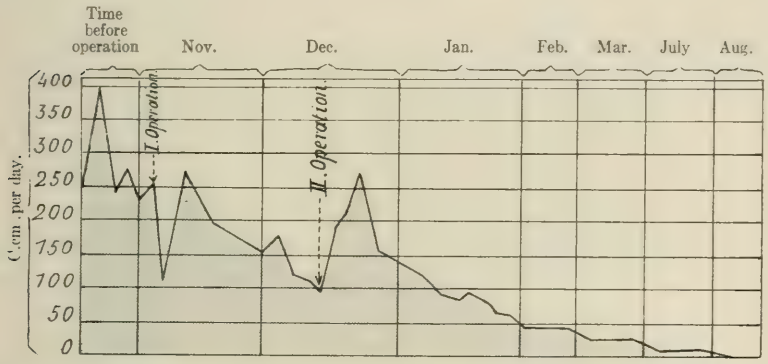

FIG. 1.—Decrease of the sputum after thoracoplasty. Before the first operation (plastic over the lower lobe) excretion 200–300–400 c.cm., afterward the maximum is 100 c.cm., after the plastic operation over the upper lobe, the excretion gradually falls to 0.

In a few of our cases, the operative restriction of the lung was followed by active tubercular processes in the lungs themselves or in other parts of the body. The fresh affections in the lung on the side of the operation are caused by aspiration in previously unaffected pulmonary parts, or in a lymphogenous extension of the tuberculosis; those of the other lung, in aspiration also, but, moreover, in sudden activity of formerly inactive and quiescent foci, in as much as the sudden absorption of toxin during the first stage of collapse causes a sort of post-operative toxin, or tuberculous reaction. In other cases we observed identical or similar consequences of insufficient auto-immunization, for instance, a sudden activity in remote foci (tuberculosis of the testicles), or, again, a carial exanthema (serum exanthema) in connection with purulent discharges, free from bacilli, at the joints and sheaths of the tendons. On the other hand, it must be maintained, that the therapeutic operations for collapse scarcely ever cause a hematogenous spread

of bacilli with subsequent development of general miliary tuberculosis; neither among the 93 pneumothorax cases of Lucius Spengler, nor in the more than 100 cases of plastic operations on the the thorax in the Zurich Clinic, do we find a single case of postoperative general miliary tuberculosis. This danger, well known to us from the resections of tubercular joints and the extirpation of tubercular kidneys, seems, in a higher degree, to be connected with the direct operations upon tubercular lungs. So, a patient of W. Müller's died, three weeks after successful excision of a lobe of the lung made necessary by caseous pneumonia, from tubercular meningitis. This proves how gentle and mild are the results of these indirect operations, in spite of the strong and sudden inversion of the mechanical and biological conditions.

A collapse of the pulmonary tissue, combined with partial or total exclusion of the organic function may today be surgicotechnically obtained through the artificial pneumothorax, extrapleural thoracoplasty, phrenicotomy, and extrapleural pneumolysis with subsequent plugging of the cavity.

The healing effect of artificial pneumothorax is no longer doubted. Statistics collected by Lucius Spengler comprising 88 pneumothorax cases, the subsequent history of which was ascertainable, show the following results:

Clinical cure (Pneumothorax disappeared since ½ to 5 years; cough and expectoration disappeared, or the latter at least, free from bacilli.)	23 cases	26.00 per cent.
Still undergoing treatment, but with favorable results	36 "	41.00 "
Considerable improvement	10 "	11.33 "
Unaffected, partly because of deformities	19 "	21.66 "
Positive results	69 patients	78.33 per cent.
Negative results	19 "	21.66 "

Therapeutic pneumothorax is indicated in all severe cases of unilateral tuberculosis (whether it be tuberculosis of the

infiltration form or tuberculosis with cavities that have been impervious to all other measures of phthisiotherapy, as well as in moderately severe progressive forms of the disease with one lung practically unaffected. A preparation of the Zurich Clinic obtained by induction shows that also those cases of bronchopneumonic tuberculosis that are accompanied by caseation, and run a comparatively acute course, can be anatomically cured by pneumothorax. This experience suggests the idea of trying therapeutic pneumothorax in cases of extensive tubercular caseous pneumonia.

Lasting success depends mainly upon the question whether a complete pneumothorax with total retraction of the lung on all sides was possible. Partial pneumothorax which secures retraction only of the sections of the lungs that are free from adhesions, does not in any way influence those parts of the lungs that are adhesive and distended. In such cases, the process cannot be completely or permanently successful. If cavities with their walls lie directly above the pneumothorax, precisely in these cases, with every new filling, there is repeated danger of a rupture of the cavity with subsequent empyema due to perforation.

Where the pneumothorax is unavailable because of the obliteration of the pleural cavity, the use of extrapleural thoracoplasty with precisely the same forms and stages of the disease is indicated. Especially favorable for this process are those forms of phthisis, in which the shrinking tendency is externally betrayed by the distortion of the trachea, the retraction of the thorax, the displacement of the heart due to traction, and by the inspiratory retraction of the intercostal spaces.

The difficulties lie less in the technique itself than in the right selection of cases suited to the operation and in the correct technical application of the manner, extent, and area of the plastic operation. Patients who suffer of severe concomitant tuberculosis in other parts of the body, who have fresh affection in the lower lobe of the other lung, or induration at the root of the lungs and foci in the region of the hilum, those who have

ulcerous intestinal tuberculosis, severe cardiac dyspnea and are in an advanced condition of debility, are to be excluded. High fever, abundance of sputum, and chronic tuberulosis of the larynx need not be regarded as contra-indications. Processes in the larynx that have not gone too far improve as the trouble with the lungs is being cured, on account of the decrease in coughing and expectoration as well as of the improvement in general condition. Treatment of patients with a high degree of dyspnea as a result of cicatricial distortion of the trachea, the hilum and the mediastinum shows particularly favorable results; so, too, the treatment of those who have phthisis with severe, protracted hemorrhages or constantly recurrent smaller hemorrhages. As the heart is considerably affected in this operation, and its healthy condition significantly increases the incipient tendency for cure, exact examination, regulation, and stimulation of the function of the heart before the operation, are essential.

Thoracoplasty is performed as partial or total operation It must be retained as working principle that with severe tubercular, unilateral phthisis, and, indeed, in any progressive unilateral tuberculosis, only the complete exclusion of the entire affected side through total plastic operation can effect a cure. Even where the lower lobe seems clinically but slightly affected, it must be absolutely included in the plastic operation. Only in this way is real quiescence of the diseased side of the lung in the relaxed state of the organ possible, and this, for physiologic-mechanical reasons, as only by these means can the urgent danger of aspiration of infectious matter from the upper lobe be avoided. Furthermore, nearly every severe phthisis of the upper lobe has smaller secondary foci in the lower lobe. Therefore when the disease is diffuse, in the presence of phthisis of the upper lobe accompanied by abundance of sputum, partial plastic operations are not only half-measures and inefficient, but really dangerous, and prejudicial to the final success of the operation.

Partial plastic operation over an area of only four to six ribs, necessitating a resection of sufficiently large portion of the ribs,

is justified only in case of tuberculosis of the lower lobe and of circumscribed tuberculosis of the upper lobe, if free from cavities, and only in cases in which the lower lobe has already suffered collapse through pneumothorax, phrenicotomy or plugging, and in this way has been protected from the danger of aspiration.

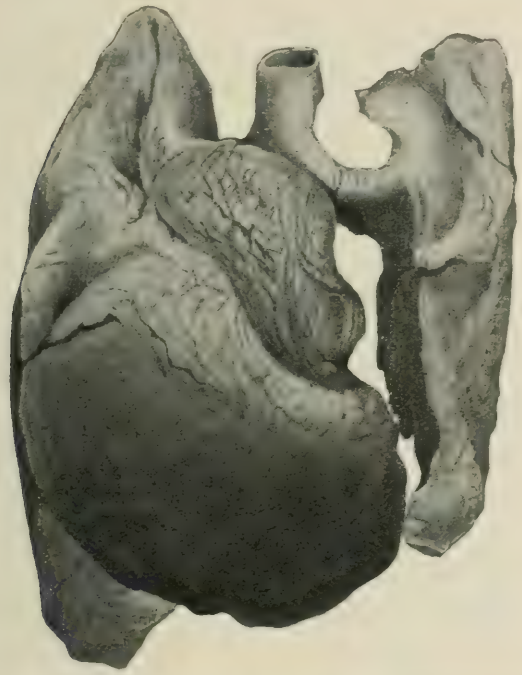

FIG. 2.—Shrinkage and restriction of the lung after thoracoplastic operation. Emphysema of the other lung.

Brauer-Friedrich's original, total "pleuropneumolysis," about which Friedrich himself delivered a lecture before you in June, 1901, with its immediate danger of loosening of the wall of the chest and displacement of the mediastinum, because of its high mortality, necessarily remained an operation to be used only in the most urgent and exceptional cases. Thoracoplastic compression of tubercular lungs could develop into a general and typical method of operation, only if it were possible while preserv-

ing the principle and effects of the operation, to free it from these dangers. Transformation of the technique has progressed so far that plastic operation within the limits marked out above regarding its indications and contra-indications, may be regarded as devoid of danger. This goal was attained, above all, by a proper extension and localization of the excision of the ribs, by the systematic use of local anesthesia, by rapid and strength-saving performance of the operation, by careful subsequent treatment of the patient upon whom the operation has been performed; but these results are due, also, to the realization that the effect of the original plastic operation of Brauer can virtually be reached by the removal of smaller parts of ribs, if the excision is made in the paravertebral sections of the ribs. Removal from the paravertebral ribs first causes the large mass of the lungs, situated in the costal wall of the vertebræ, to collapse. If the ribs are severed towards the back, as near as possible to the spinal column, the inner edge of the scapula is later caught fast under the stumps of the ribs; the weight of the arm and the shoulder girdle increases the effect of compression by means of the tampon-like pressure of the scapula; on the other hand, the latter forms a sort of osseous replacement of the wall of the chest in the actual field of resection. The dreaded displacement of the mediastinum toward the unaffected side, and the spacial restriction of the other lung are only slight; loosening of the mediastinum and paradoxic breathing are not to be feared at all.

The main dangers of the original plastic operation of Brauer can therefore be avoided in two ways:

1. Where the anatomy of the process demands absolute quiescence and the greatest possible relaxation of the lung, through performing Brauer's extensive resection of the ribs by two stages, in the first of which, the ribs covering the lower lobe are to be removed, and only in the second, those of the upper lobe.

2. By the less extensive paravertebral resection of the first to tenth or first to eleventh rib. The extent of the area of

resection in the separate ribs, over the lower lobe, depends upon the degree to which the lower lobe has been affected. If the lungs are already covered with exudates or a pneumothoracic vesicle, the danger of symptoms of displacement is increased and must be reckoned with; in the regulation of the operation as

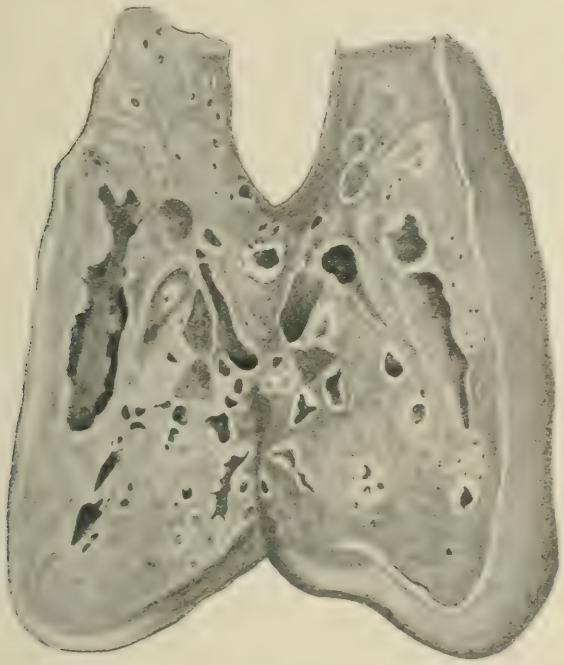

FIG. 3.—Cross-section of a thoracoplastic lung. Twenty-two days after total plastic operation. Woman, aged thirty-four years. Phthisis of the left lung, with cavities for seventeen years. Complete collapse of the cavities, remarkable onset of extensive growth of connective tissue throughout the lung, in and about the foci.

concerns the number of the ribs and the length of the portions to be excised, peculiarly careful control of the patient during the operation is necessary, in some cases to be assisted by the method of maintaining increased pressure.

The technique of our operation today is the following: Preliminary treatment with digalen when patients suffer from

weakness of heart action. Clearing the throat as much as possible before the operation. Local anesthesia with 0.5 per cent. novocain solution (maximum 150 to 200 c.c.); an hour before the operation, subcutaneous injection of morphin. The patient lies on the sound side with the upper part of the body raised, while the arm on the affected side is drawn upward and to the front. Paravertebral incision of the breadth of three fingers from the spinous process outward, passing upwards beyond the acromion, turning frontad hook-like above the tenth rib. The scapula is raised and held apart by means of a large blunt tenaculum. Subperiosteal denudation of each rib by longitudinal incision of the periosteum with a scalpel, pushing the outer part of the periosteum upward and downward with pledgets, and by freeing the rib from the inner part of the periosteum with Doyens' raspatory. The length of the resection at the lower ribs, 6 to 10, at the upper, 3 to 6 cm. The resection begins at the ninth or tenth rib and continues upward to the first. It is necessary to resect the ribs in the back close by the transverse process of the corresponding vertebra, and important furthermore, finally to resect small portions of the tenth and occasionally of the eleventh rib, since only in this way can the diaphragm be relaxed and also mobilized, and the lung deprived of its inspiratory power.

Particularly deep cavities or those with exceptionally rigid walls in the apex of the lungs occasionally remain unaffected by the mechanical effects of plastic operation. These cases demand, in addition, a subsequent extrapleural apicolysis and plugging, for the efficacy of which the preceding plastic operation has created especially favorable conditions.

Phthises with cavities that are complicated with sanious pyopneumothorax, whether as the result of spontaneous rupture of the cavity with open pleura, or of the eruption of a cavity into an artificial pneumothorax or of perforation of a tubercular empyema in the direction of the bronchial tree, also phthises which are accompanied by tuberculous peripheral empyemas, call for a particularly careful method of treatment:

1. With tuberculous empyemas that have spontaneously broken outward, a sufficient exit for the pus must be prepared by resection of the ribs.

2. The tuberculous empyemas that have a wide-open eruption in the direction of the bronchi, also necessitate a resection of the ribs because of the danger of aspiration.

3. In cases with sanious pyopneumothorax as a result of rupture of the cavity, a new collection of the exudate can be checked and prevented by a plastic operation on the thorax in several stages. In the treatment of this most dangerous complication of artificial pneumothorax, a suggestion of Lucius Spengler has been put to excellent account: Large discharges with strongly positive exudation pressure are first reduced by puncture, a precaution that is not necessary in cases where there is only a small exudate. A few days later, an extensive plastic operation is performed at the lower half of the thorax in order to diminish the size of the cavity; then a few weeks later a second, and even in case of need a third, still more extensive plastic operation in the upper section of the thorax supplements the former. By this process, the cavity is indirectly emptied or it can without danger be closed later by Schede's method.

Rare and exceptional complications of plastic operation were observed in a severe case of phthisis due to mixed infection following an apicolysis in addition to the plastic operation, a septic induration phlegmon, and fatal mediastinitis, and, in another exceptional case, an aneurysm of an intercostal artery which, six weeks after the operation, burst into the lung.

The objection of a severe resulting deformity that has been brought against Brauer's original plastic operation, is obviated by recent changes in technique. Even a total paravertebral restriction of the lung leads to no severe mutilation of the patient. The function of the arm on the operated side, in spite of the sinking-in of the scapula and the severing of the muscles that support it, was completely preserved in every case, thanks to a careful restoration of the individual layers of muscles by ligatures, and to careful subsequent treatment.

Statistics of the cases treated in the Zurich Clinic give some idea of the results produced in this difficult field by up-to-date precautions and technical appliances.

Total number of extrapleural thoracoplastic operations for tuberculosis			140	
A. Thoracoplastic operations in tuberculosis without rupture of the cavity			122	
Cured	24	patients	19.7	per cent.
Considerably improved	30	"	24.6	"
Improved	32	"	26.2	"
Grown worse or unimproved	4	"	3.9	"
Deaths from operation	3	"	2.5	"
Later deaths, after weeks, months or years from progressive tuberculosis.	25	"	20.5	"
Still undergoing treatment	4	"		
	122			
B. Thoracoplastic operations in tuberculosis with rupture of the cavity				
Cured	7	"	18.0	"
Deaths from operation	4	"	38.9	"
Later deaths (mostly amyloid embolism)	6	"	22.0	"
Still undergoing treatment	1	"	33.0	"
	18			

A new solution of the problem of functional exclusion of tubercular lungs was discovered recently, *i. e.*, the production of a state of quiescence of at least the lower lobe region through inducing artificial semilateral paralysis of the diaphragm by means of phrenicotomy (Stuertz, Sauerbruch). The paralyzed side of the diaphragm rises three or four inches, whereupon the pressure of the abdominal organs that rise to the arch of the diaphragm produces compression of the lower lobe. Brauer had already conceived the idea of increasing the effect of resecting the bones of the thorax by raising the diaphragm and by excluding the diaphragmatic tension, expected to reduce as far as possible the further participation of the collapsed lung in respiration.

Technique of the operation: In local anesthesia, the nerve is followed in its course over the scalenus anticus, while the patient

is in a half-sitting posture, and is then severed by an incision that extends from the outer margin of the sternocleidomastoid muscle to the middle of the collar bone. It must be observed here that anatomic variations are frequently found in the phrenic nerve in regard to the vena subclavia (in its course in front or in back of the vein), that an accessory nervus phrenicus and fasciculi of fibers from the N. descendens hypoglossi may be found there.[1] In the moment of severing the nerve, the patient who is being operated upon feels a sudden pain in the shoulder and hypochondrium combined with a twitching start in the muscle.

The operation is absolutely devoid of danger, a fact that must be maintained against an observation of Mackenzie,[2] who saw a traumatic rupture of the right phrenicus followed by immediate death.

After the phrenicotomy, the diaphragm appears in front of the *x*-ray screen and in the skiagram in the raised position of expiration (the minimum being 2 to 3 cm.), the proof of which may be made impossible because of induration, while its extent may be diminished by existent pleuritic adhesions. The muscle is at a standstill or shows a paradoxic change in its type of movement like the displacement of the tongue of a balance. In the skiagraph the pulmonary region even with the deepest inspiration remains somewhat darkened in the lower lobe. The spirometer shows a reduction of the capacity to two thirds;

[1] Cf. Cavalie, Innervation du diaphragme par les nerfs intercostaux chez les maniferres et chez les oiseaux, Jour. de l'Anat. 1898, p. 5. Heinricus, Sur les modifications de la respiration et de la circulation a la section de nerfs phreniques, Finska lak. sallsk. handl. Helsingfors, 1888, xxx, 117 to 133. Larkin, Accessory phrenic nerve, Jour. Anat. and Physiol., London, 1888, 1889, xxiii, 340. Turner, A Phrenic Nerve Receiving a Root of Origin from the Descendens Hypoglossi, Jour. Anat. and Physiol., London, 1892, 1993, xxvii, 427. Fawcett, The Left Phrenic Nerve with Abnormal Course Relative to the Subclavian Vein, Jour. Anat. and Physiol., London, 1893, 1894, xxviii, 464.

[2] Mackenzie, A Case of Rupture of the Right Phrenic Nerve Followed by Instantaneous Death. In His Med. Leg. Experience in Calcutta. Edinburgh, 1891, p. 99.

physiologically, a retardation and lowering of the pleural absorption is noticeable. The diaphragm, even with deepest inspiration retains its parabolic (expiratory) form. Phrenicotomy on the left side causes a raising of the apex of the heart, turning of the heart about the vascular root, and broadening of the cardiac shadow. Anatomically, the operation is followed by a partial degeneration of the nerve, from which are excepted only those fibers that radiate below the place of severing, from the ganglion cervicale inf., as well as by simple atrophy and fatty degeneration of the muscle.

For the severing of the nerve may be substituted blocking by the injection of alcohol or osmic acid into the nerve that has been exposed by the operation.

Clinically, on the day following the operation, there is nearly always a moderate rise in temperature (absorption of the toxin). The artificial semilateral paralysis of the diaphragm but rarely plays an independent role; mostly it is combined with a larger complex plan of operation, as first or last act. The experience of the Zurich Clinic with more than 30 cases permits of the following statement: With lymphoid isolated tuberculosis of the lower lobe, this artificial paralysis may, by itself, in favorable cases, produce a clinical cure, but in cases of progressive tuberculosis of the lower lobe and that with cavities, only when it is combined with partial plastic operation. Where a partial plastic operation or plugging of the isolated diseased upper lobe is planned, the placing of the lower lobe in a condition of quiescence through phrenicotomy may avoid the danger of aspiration.

The operations that have so far been described, are operations of a more passive kind to secure relaxation, *i. e.*, operations that set aside obstacles of shrinking, but which otherwise leave the mobilized lung to itself. A more active principle lies in the operation founded by Schlange, Tuffier, and Friedrich, and further developed by Baer, namely, the extrapleural extirpation of sections of the lungs that are permeated with cavities and plugging of the cavity thus obtained with adipose tissue (Tuffier), vioform paraffin (Baer), nitrogen (Mayer), a colpeurynter-like

bag (Gwerder, Kroh) or simple application of tampon in the cavity (Jessen).

From purely biological considerations, it seems that preference ought to be given to Tuffier's organic plugging material. But, owing to its nature, adipose tissue cannot be a substance really capable of pressure, such as would crush together rigid cavities until their walls touched and collapsed. Furthermore, there is the danger of a secondary tubercular affection of the adipose plugging mass, a possibility not excluded by the favorable experiment made with adipose tissue of Makkas in plugging tubercular bone cavities, nor even by the observation of Tuffier that an adipose plug of 250 gr. was found four months later to be histologically normal. On the other hand, the paraffin plugging has the advantage of exerting steady pressure and of remaining for a long time unchanged.

The technique is easy. For total plugging-compression of an entire side of the lung, the intercostal area between the fifth and sixth rib is recommended for the incision. The choice of the place for operation in partial plugging is indicated by the location of the cavity. For the most commonplace of cavity plugging, for the compression of the cavernous upper lobe, I should suggest instead of the axillary or infraclavicular process (Tuffier, Baer), a paravertebral opening of ribs. In local anesthesia, after a paravertebral longitudinal incision passing tenaculum-like over the acromion, an opening is made through the resection of 3 cm. long portions of the second and third rib; the extirpation of the upper lobe with all its bulk up to the front is easily effected from this position. The blood in the cavity thus formed is carefully dried with a solution of peroxide of hydrogen, in order to bring the plugging mass into direct contact with the wall of the cavity. Since the pleural indurations occasionally enclose bacterial deposits, it is useful to rub out the wall of the cavity with iodoform powder; this also facilitates the subsequent skiographic portrayal of the plugging. As material for the plugging, pure paraffin can be used or paraffin saturated with a 5 per cent. addition of iodoform or vioform.

which must have the consistency of the well-known plastulin mass or of modelling clay, and which is inserted with a spatula in little pieces into the cavity up to the level of the rib opening. The paravertebral insertion of the plugging mass has the following advantages: The plugging mass compresses the upper lobe in a vertical axis—from base to apex—not in the direction of the hilum; the danger of compression of the major bloodvessels is considerably diminished; the thick layers of muscles combined with the pressure of the shoulder blade prevents spontaneous ejection of the plugging material; finally, this method of procedure during the act of plugging, causes the cavity to be slowly pressed to emptiness from the periphery, and in this way the danger of displacement of its exit by the pressure of the plug is avoided. The plugs employed contained up to 1800 gr. For partial plugging local anesthesia suffices. The operation may be performed bilaterally if both upper lobes are affected.

The experience of the Zurich Clinic with 23 cases shows the efficacy of the method when applied to the proper cases; in one case, the original daily sputum of 100 c.c. disappeared in eight days after the operation; in another, it decreased in three weeks from 150 to 20 c.c. But this method is not free from danger. These dangers are:

(*a*) Secondary wanderings of the plugging mass, which may be prevented by careful and extensive fleshy covering of the rib opening, and by substituting for resection osteoplastic closure.

(*b*) Necrosis due to pressure of the cavity wall with breaking of the plugging mass into the cavity, a complication apparently not fatal.

(*c*) Rupture of the cavity with subsequent emphysema, an event that compelled Wilms to remove the plug.

(*d*) Pressure symptoms of the heart and the major bloodvessels, clinically recognizable through the change in heart action, pulse, and color of the face; they are to be feared, especially in cases of total plugging or plugging on the left side and when the plugging mass is inserted from the front or side, and they necessitate immediate removal of the plug.

(*e*) Formations of a fistula with spontaneous ejection of parts of the plugging matter.

(*f*) Formation of extrapleural induration abscesses, which occurs especially in severe phthises due to mixed infection behind the plug. These abscesses gather and occasionally cause severe septic symptoms (five times out of twenty-two; similar experiences have been reported by Wilms and Baer); here, too, rapid removal of the plugging mass and tamponade of the cavity are necessary.

(*g*) Severe hemorrhage, necessitating tamponade during extirpation of the lung.

(*h*) Mediastinal displacement in cases when the mediastinum is not fixed, but elastic, and the insertion of the plugging matter is excessive. Finally,

(*i*) In isolated plugging of upper lobe tuberculosis with abundance of sputum without preceding exclusion of the lower lobe, danger of aspiration reappears.

None of our patients succumbed to the operation or its consequences. But the list of accidents, not a small one, shows how important it is, in these cases also, to build, first a protecting wall about the region to be plugged by means of previous partial pneumothorax or partial plastic operation, and how carefully the suitable cases must be selected. On the basis of our experience, the following indications must be considered:

(*a*) For total plugging: Demonstrable rigidity of the mediastinum and serious general condition, which forbids more extensive plastic operation.

(*b*) For partial plugging: Paravertebral compression of the upper lobe above pneumothorax of the lower lobe; subsequent compression of rigid wall apical and subapical cavities, which had not sufficiently collapsed through preceding plastic restriction; compression of remaining cavities free from tuberculosis bacilli; infiltration form of tuberculosis of the upper lobe, with only slight sputum, plugging compression of the upper lobe after previous exclusion of the lower lobe through phrenicotomy.

So multiform a disease as tuberculosis of the lungs cannot

have a so-called typical operation. Precisely here we need a large register of operative attempts. The following possibilities for the future shall be briefly enumerated:

1. Where only a basal partial pneumothorax could be performed upon the lower lobe region, and there exists the possibility of an easy excision of the adhesive upper lobe, total pneumothorax can be induced by intrapleural extirpation of the upper lobe. Sauerbruch has already twice attempted this with success.

2. The proliferation of connective tissue and shrinking of the lungs caused by ligature of the arteries leads also to an encapsulation, intergrowth, and thereby, healing of tubercular foci. Kawamura[1] discovered as effect of ligature of the pulmonalis in animals previously inoculated with tuberculosis, that the foci of the disease in the shrunken lobe of the lung became surrounded with thick layers of connective tissue, that they contained abundance of lime salts and scarcely any tuberculosis bacilli. This method, supplemented by a subsequent partial plastic operation, would be applied in circumscribed tuberculosis of the lobe.

3. A circumscribed compression of a single lobe may be effected experimentally by intrapleural wrapping and enclosing of the lobe concerned in a large piece of fascia which is taken from the fascia lata and freely transplanted.[2]

4. Compression shrinking of the highest grade may be produced experimentally in the lower lobe, by its displacement below the diaphragm, a method to be applied to the isolated tuberculosis of the lower lobe which cases are, prognostically, so unfavorable.[3]

5. A restriction of the inner space of the thoracic cavity of any desired degree, is theoretically conceivable, through resec-

[1] Ueber die kunstliche Erzeugung von Lungen-Schrumpfung durch Unterbindung der Pulmonalarterienaste und den Einfluss derselben auf die Lungentuberkulose, Deutsche Zeitschr. f. Chirurgie, Band 25, S. 373.

[2] Henschen, Experimente zur intrathorakalen Lungenchirurgie, Bruns Beiträge zur klin. Chirurgie, 1914.

[3] Henschen, Experimente zur intrathorakalen Lungenchirurgie, Bruns Beiträge zur klin. Chirurgie, 1914.

tion and artificial raising of one side of the diaphragm to the desired level of the higher rib. If there are extensive adhesions between the base of the lungs and the diaphragm, the operation would also be technically simple.

It was my task to show you the remarkable results already attained by surgical treatment of tuberculosis of the lungs; these results are of increased importance as having been gained in so-called hopeless and desperate cases. To what extent this clinical cure implies a real and final anatomic cure, and how many of the patients temporarily cured will succumb to a reappearance of apparently encapsuled foci, remains to be seen in the future.

SUMMARY. 1. Severe and moderately severe unilateral cases of tuberculosis, infiltration forms and those with cavities, especially those that show a tendency to shrinking, which defy purely internal treatment, can be cured clinically and anatomically by therapeutic operations that produce collapse and relaxation.

2. Every collapse therapy must begin with the attempt at artificial pneumothorax. This operation having a sparing as well as an active effect, alone makes possible knowledge of the presence and extent of pleural adhesions.

3. If these exclude therapeutic pneumothorax, the indication is, in general, for extrapleural thoracoplasty.

4. Partial plastic operations are indicated and free from danger only in cases of infiltrating forms of tuberculosis, of the upper lobe, with little sputum, and in cases of isolated tuberculosis of the lower lobe; and only after previous exclusion of the lower lobe through pneumothorax, phrenicotomy, or plugging; and, finally, in cases of phthisis of the upper pulmonary regions, with abundance of sputum.

5. All cases of diffuse, unilateral tuberculosis, as well as those of phthisis with cavities and abundance of sputum, of the upper lobe, demand total plastic operation, complete relaxation of the entire side affected, in order to exclude the danger of aspiration.

6. For the treatment of infiltrating tuberculosis and forms with small cavities, semilateral relaxation through paravertebral resection of the first to tenth, or first to eleventh rib, suffices.

7. Cases of phthisis with large cavities in which the lower lobe is especially affected, need extensive plastic operations according to Brauer's method.

8. Non-virulent, infiltrating, and slowly progressing tuberculosis of the lower lobe, are in some cases amenable to phrenicotomy.

9. Rigid cavities in the upper lobe can be favorably influenced and cured, after previous plastic operation, by subsequent, circumscribed, extrapleural plugging.

II. Surgical Treatment of Bronchiectases. Efficient as the methods of relaxation and compression have proved to be in cases of inflammatory diseases of the parenchyma, these methods have failed to produce real cures or permanent results in surgical cases of inflammation of the system of bronchial tubes, the cases of bronchiectasis. There are various reasons why even in favorable cases of this type the results are always partial and incomplete, namely, the groping uncertainty of the diagnosis, the unfavorable anatomic conditions, the manifold complications in advanced cases of the disease, the restriction—in our opinion excessive—of the operation to the later phases of the disease, and last but not least of all, the fact that the methods of relaxation and compression that are so successful in inflammations of the compressible parenchyma, cannot be directly transferred, without change in technique, to suppurative affections of the canals and cavities of the barely pliable and cartilaginous bronchial tubes.

It must be maintained that our present knowledge of the origin, anatomy, and clinical entity of bronchiectasis is as yet too fragmentary to make possible, at the moment, the development of sufficiently clear anatomic and clinical schemes and their establishment as foundations for exactly formulated principles of treatment. All these attempts at clinical differentiation are sensibly increased in difficulty by the various and changing forms of transition to abscess of the lungs, gangrene, and secondary, tubercularly affected bronchiectasis.

Etiologically the following rather clearly defined forms of bronchiectasis may be distinguished:

1. Heller's fetal or atelectatic bronchiectasis, originating in fetal atelectasis of sections of the lungs that remained undeveloped even after birth; in such cases the pressure of the growing bronchial tree may affect the interstitial tissue and cause cirrhotic transformation, but a more probable foundation for the disease seems to be congenital arrest of development. The anatomic symptom of fetal bronchiectasis is the absence of anthracotic pigment in parts of a lobe of the lung that appear reduced, void of air, hard, permeated with ectatic cavities, or at least, a strange and unusual distribution of what little pigment there is, the scarceness of which may form a striking contrast to the wealth of sooty pigment in other parts of the lungs. Further symptoms are the retention of fetal pulmonary tissue, a strikingly cartilaginous wall-formation, the predominance of the pavement epithelium over the ciliated epithelium, the additional presence of malformation of the chest-wall, or other congenital anomalies (open foramen ovale, lipoma of the lung). Fetal ectasis occurs in all the lobes of the lungs, but preferably in the upper lobe. The presence of a high degree of fetal atelectasis excludes capability of life, but sufferers from fetal atelectasis that is confined to one lobe or to restricted regions of a lobe, may live to old age. Herxheimer's and Buchmann's experience included persons from fifty to ninety years of age. Among the clinical symptoms of these cases the following are noticeable: the slight reaction upon the heart and their deceptive similarity with tuberculous phthisis (fever, hemoptysis, lack of appetite, similar findings in percussion and auscultation).

These statements made by pathological anatomists force us to the conclusion that in a considerable number of cases of inflammatory bronchiectasis, congenital, or hereditary influences play a prominent part, a view first expressed by Grainger Stewart, to which both Körte and Sauerbruch incline. More exact investigations into the rôle played by heredity, by congenital lues, etc., have not, within my knowledge, been made. On the other hand, much that is contradictory and mysterious in the origin, progress, anatomy, and clinical entity of the disease can be explained

only by the assumption of congenital or hereditary influences. The investigations of Narath and others have enlightened us as regards the countless variations in number and ramification, the so-called floating of the bronchi, anomalies of development of retrogressive or progressive nature, retarded outbranching, defective division and development of the cartilaginous parts of the bronchial tree. This extraordinary number of variations in the bronchial framework of the lungs, the all but systematic multiple occurrence of bronchiectasis, the beginning, often in youth, of the first symptoms, usually for a long time ambiguous, the combination with other forms of anomalous development (semilateral hypertrophy of the body, lipoma of the lower lobe, etc.) make it highly probable that an inherited or congenital weakness of the bronchial tube system and perhaps primary anomalies in the formation of its caliber are the final cause of many cases of common inflammatory bronchiectasis. Morphological or functional weakness of the lungs will be evinced, first of all, in increased sensitiveness and diminished power of defending the organ against infection, so that we actually find in the previous history of most sufferers with bronchiectasis, a surprising amount of pneumonia and pleuritis. Körte also inclines to the view that repeated inflammations or traumatic injuries of the lungs or pleura are only of secondary importance as releasing causes. Further aggravations are created by disturbance of the mechanism of respiration due to abnormally formed bronchial tubes: in expiration, the elastic bronchial tube not only suffers narrowing of its tongues of cartilage, but together with the expiratory contraction, experiences spiral rotation; the bronchial tubes are, therefore, in expiration, trained like a spring. Primary weakness of the bronchial wall or primary inflammatory changes in it necessarily, during inspiration, affect in an injurious way the compressibility as well as the relaxability of these bronchial springs, and thus impair greatly the respiratory capacity of the lungs.

2. Very near the atelectatic ectases are the so-called congenital bronchiectases (cystic lung, honeycomb lung, or sac

lung), really malformations of the tissue of no surgical significance.

3. The same is true for vicarious or functional dilatations of the bronchial tubes which appear as collateral and compensatory symptoms in the neighborhood of shrinking parts of the lungs, after the circumscribed bronchopneumonia, atelectasis and infarcts, but with preference develop in a more diffuse form in connection with tuberculosis and emphysema. Only in rare cases are they transformed and developed into inflammatory ectasis.

4. The great majority of bronchiectases develop clinically in connection with primary inflammatory diseases of the bronchi themselves or of the parenchyma and the pleural covering of the lungs. The etiologically subordinate forms of these inflammatory bronchiectases are stenotic bronchiectasis, indurated bronchiectasis (cirrhotic, postempyematic ectasis), ectasis due to pleuritic exudations of long duration, bronchiectasis due to the presence of foreign bodies in the lung, and Morley's bronchiolectasis, the last of which is multiple and appears usually in acute form in the smaller ramifications of the bronchi.

Under the general concept of bronchiectasis, therefore, are included a number of most variable processes, processes which, according to their origin, nature, as well as to their localization and length of duration, present the greatest differences (Brauer). The actual surgical forms are the fetal atelectatic and the inflammatory bronchial ectasis.

For the surgeon, the division into separate etiological forms is of less significance than the necessity for a more topographical orientation regarding the location, extent, and anatomic condition of the wall in bronchial ectasis. The answer to these very questions must decide the choice of the method of operation, after the patient's general condition, and the temporal and clinical phase of the disease have been ascertained.

Important in this connection before all others is the fact that completely developed ectasis occurs with by far the greatest frequency in the lower lobe, after that, in the middle lobe, and only rarely in the upper lobe. This preference for the lower lobe

is easily explained, especially for cases of bronchial ectasis of of inflammatory origin. Bronchiectasis of the upper lobe will in most cases be a primary fetal atelectatic ectasis, and will in any case arise for the most part on a foundation of congenital or hereditary influences. To quote numbers, v. Criegern found among 49 cases of bronchial ectasis only one of the upper lobe; Tuffier found among 45 cases of bronchial ectasis 40 of circumscribed bronchial ectasis of the lower lobe; the Zurich Clinic found among 27, 20. Within our experience, the left lower lobe is the most common seat of the disease. The bronchiectatic single cavity is rare; nearly always there are found in a circumscribed region of the lobe, or in an entire lobe of the lung, numerous systems of cavities in rows, one after another, or of a sponge-like formation. In one-third of his cases Körte found a regular systemic disease of both lungs. But even the apparently pure lobular bronchial ectasis of one lower lobe is often connected with a chronic "collateral" bronchitis of the other parts of the bronchial tree which is clinically as well as anatomically free from ectasis; the sputum from the bronchitis may then survive the cure of ectasis.

The potential efficacy of all operative methods which attempt to secure diminution and obliteration of bronchial cavities by means of relaxation, compression, and shrinking of the connective tissue of the lung is anatomically determined by the central or peripheral location and by the condition of the walls of the cavities.

The central bronchiectases grouped directly about the hilum (parahilous ectases) of the principal and collateral branches of the bronchi are nearly always multiple and very often dactylate. The large and sound covering of the parenchyma which surrounds them, conceals their clinical and physical symptoms, disguising them in such a way that precisely the diagnosis of these forms finds increased difficulty. Anatomically they present a picture of wholly rigid, little, or scarcely compressible, ectases. Their wall, already stiffened by the considerable interposition of cartilage, becomes still more rigid and inflexible through hyper-

trophy of nearly all its structural parts, the mucous membrane, glands, cartilage, and muscularis, through calcific deposits not only in the cartilage, but also in the connective tissue, in the muscles, and even in the epithelium, through partial ossification of individual cartilaginous areas, finally through fibrous growths of connective tissue, which continually surround the ectases with new cicatricial rings, increase the rigidity of the wall, or, with eccentric tractional power extend the ectasis. Against these rigid walls even the force of concentrically shrinking pulmonary and pleural callosities is broken, and in these cases even operations constricting the lungs and thorax must fail, the effect of which would, in any case, be considerably weakened before reaching the hilum. Precisely in these forms the pleura often remains for a long time unaffected.

Peripheral or terminal bronchiectasis presents an essentially different picture. Here the smaller tubes are attacked, the bronchioles, the infundibula, and often too, the alveoli in the form of so-called pulmonary vacuoles additionally affected. Being as a rule, very numerous, they transform especially the cortical part of the lung into cavernous tissue, which then resembles a sponge filled with purulent phlegm. These bronchiectases of the pulmonary cortex, of the smaller bronchial tubes, and the connective tubes are observed to occur with remarkable frequency after cases of infarct and bronchial pneumonia. Morley's bronchiolectasis, of very multiple appearance, attacking preferably the smaller tubes, the acquired bronchiectatic Wabenlunge (honeycomb lung) follows frequently upon measles and pertussis-pneumonia in childhood, and influenzal pneumonia in more advanced years. The onset and course of the disease are extraordinarily rapid especially in this form (so-called acute bronchial ectasis). Precisely this form of ectasis, through spread of the inflammation to the pleural covering, leads early and frequently to extensive callous adhesions of the lung to the wall of the chest. This rigid adhesion of the lung, even when anatomically there are incipient signs of cure, permits no shrinking in the dilated lung, which is the necessary condition

of the cure. Its more peripheral location, its soft walls amenable to pressure, make these bronchial ectases of the pulmonary cortex far more accessible to operative treatment for collapse and shrinking than are the central forms with rigid walls, first described. This falls in line with Lenhartz's experience that precisely acute bronchial ectases are favorable for surgical operations. Moreover, lues of the bronchial tree, especially in its diffuse infiltrating form, usually ends in ectasation precisely of the bronchioles and the alveoli. Many of the pleurogenous induration ectases, also, belong to these cortical bronchial ectases, and among them especially those which after severe empyema develop with excessive rapidity.

Unfortunately, even when the diagnosis of bronchiectasis, itself so difficult in so many cases, is assured, it is often at the present day impossible to make an exact topical diagnosis of depth of location, number and extent of the bronchiectatic cavities. The skiagram, a proved and dependable counsellor in diseases of the parenchyma, here, within our experience, often misleads even trained eyes. It is mostly necessary to take a series of *x*-ray pictures of the cavities at various stages of their contents. Diagnostic bronchoscopy has proved to be at once unsafe and dangerous. The best guides in the diagnosis of bronchiectasis are even yet the physical examination, Quincke's localization test, the nature of the excretion, and the manner of expectoration.

Bronchiectases that have reached full development anatomically and clinically, especially the central cavities with their rigid walls, could scarcely heal spontaneously. In this they resemble absolutely the protracted suppuration of old empyemic cavities. Furthermore (according to Brauer), in contrast to the tuberculous cavities in the chronic suppuration of rigid cavities, the capacity of effective demarcation and anatomic purification of their walls is lacking. Nevertheless, under favorable conditions, incipient tendencies to healing are occasionally to be found. This healing proceeds anatomically in two different ways: Cavities with soft walls, or even larger ectases, the cartilage of

which has been destroyed by ulcers or atrophied by compression, may, through the pressure of peribronchial cicatricial rings, be crushed together to narrow, star-like pockets, whereupon the walls grow into one another, and obliteration of the cavities takes place. It more frequently happens that afferent and efferent bronchi become obliterated and that their canal, shut off on all sides from communication, is transformed into a cavity filled with mucus and serum, the contents of which may harden and calcinate. It is apparently not known whether such a polycystic transformation of ectatic bronchial regions occurs also in large areas (secondary cystic lung, due to bronchiectasis).

The patients who underwent operation in the Zurich Clinic, exemplified, clinically and anatomically, almost exclusively late cases. The indications for surgical operation were ulcerous, disintegrating, and progressive processes in the cavities with copious putrid sputum and severe septic infectious reaction upon the general condition, phthisis-like hectic marasmus, tendency to relapsing hemorrhages and pneumonias, above all, severe injury to the social and economic activities of the patient.

Among the operative attempts, procedure by injection, and the method of trocar drainage is only of historic interest. The operative procedure, which has been clinically tested at the present time, and of which a definite valuation is possible, is divided into two large groups:

(*a*) Indirect extrapulmonary operations, which aim to secure obliteration and diminution of systems of bronchiectatic cavities through relaxation, compression, or artificial production of shrinking by growth of connective tissue.

(*b*) Direct intrapulmonary operations, comprising methods of drainage, resection, and amputation.

The results of the relaxation of the lungs through artificial pneumothorax with injection of nitrogen, only a transitory and not a permanent therapeutic method, are scarcely worthy of mention. This is easily understood if one considers the anatomic peculiarity of the disease. Besides, if, according to Tuffier, pleural adhesions are found in more than 50 per cent. of the cases,

according to Garré in even more than 80 per cent., very narrow limits would have to be set for the artificial pneumothorax. The cases of bronchial ectasis treated in the Zurich Clinic were, however, for the most part, free from adhesions. Temporary improvement (decrease in the sputum, diminution of the putrid odor, retrogression of fever, and hemorrhages) has often been secured for a short time by means of pneumothorax. Likewise it seems more than questionable, how far its results are lasting and permanent in early stages of the disease.

A compression really effective both in duration and degree is possible in bronchiectasis only through extensive extrapleural thoracoplasty. Of 14 cases treated by thoracoplasty at the Zurich Clinic, 3 were improved in condition so as to be nearly cured, 4 others were somewhat improved. In the remaining 7 scarcely any results were visible. The operation itself was undergone by all the patients without any danger. The compression resulting from the plastic operation increased by the effect of bandages, in connection with the subsequent proliferation of the connective tissue, produced a sort of autopurification of the bronchiectatic cavities, which evinced itself clinically in the considerable decrease of the sputum and in the disappearance of the putrid odor. This favorable result is due to the emptying and destruction through pressure of bronchiectatic secondary cavities and canals in which the secretion usually collects and decomposes, to the disappearance of putrid-septic intoxication and to the lowering of the bacterial permeability of the pulmonary tissue through the growth and proliferation of broad cicatricial areas. The rigid, and above all, the central parahilous forms remain unaffected even by the plastic operation. If, in connection with the operation, a rich growth of connective tissue sets in throughout the lung, the effect of this pressure must, for the most part, be exhausted already in the rigid and callous peripheral part of the lung. In my opinion, compression in cases of cavities near the hilum, cannot be efficient, because the necessary counter-pressure is lacking in this region. It is even conceivable that in the bronchostenotic forms of bronchiectasis, the stenosis is

aggravated, and, as a result, there is increase in secretion and decomposition, due to the mechanical effects of the operation and its influence upon the tissue. Lenhartz records a permanent cure after plastic operation in a case of callous ectasis of the lower lobe.

The value of thoracoplasty may therefore be summarized as follows: In bronchiectasis of acute origin, an apparently permanent cure has been reached by early operation in a few cases; in chronic and fixed ectasis there has been extensive improvement in about half the cases, but never clinical, much less anatomic cure. The best results of the extensive plastic operation are secured in soft cortical bronchial ectases that are neither cartilaginous, nor rigid with connective tissue, such as sometimes develop acutely after pneumonia or empyema. In order to insure success, there must be an early operation and restriction of the disease to one lobe, if possible to only one side. In primary disease of the bronchial system, all mechanical measures promise only slight success; their importance lies in the fact that they prepare and free from danger the only correct operation in these cases, pneumectomy.

The same restrictions regarding results and the identical indications hold good also for the Tuffier-Baer method of extrapleural pneumolysis and compression of the lungs by plugging with adipose matter or paraffin. Here, too, there is no chance of complete and permanent cure, because the part of the lobe near the hilum withdraws toward the median line in compression.

In order to exclude obstacles to shrinking in the entire periphery of the diseased lobe of the lung, Garrè combined thoracoplasty with total removal of the lower lobe from the complementary area, and with artificial folding and displacement of the organ to the level of the diaphragm; the empty space included between the apex of the lung, the diaphragm, the heart, and the spinal column was tamponed, and afterward obliterated completely, with the same result: considerable improvement; no cure. Here, too, the absence of complete success is easily intelligible, anatomically; free possibility of shrinking.

and consequently diminution of the cavities and clinical improvement in the compression stage; secondary redevelopment of the bronchiectatic system of cavities through centrifugal cicatricial traction as soon as the displaced lung, after obliteration of the tampon cavity is reëxposed to the tractional power of its adhesions, and to the developing suctorial power of the diaphragm. The effect of this method of Garrè's could, in my opinion, be essentially increased and extended, if, with the lower lobe, the diaphragm part adherent to its base, could be mobilized by circular circumcision, be pushed upward as far as possible into the thoracic cavity, and be here fastened again by a suture.

Artificial unilateral paralysis of the diaphragm by phrenicotomy may, even in bronchiectasis, as a preparatory and auxiliary measure, help to increase the effect of relaxing operations. By itself, it can, only in early cases, produce improvement in the condition through decrease and mucous transformation of a previously purulent sputum.

A particularly high degree of transformation in the connective tissue and shrinking of the lung can be produced artificially through ligature of separate lobe branches of the arteria pulmonalis. This process, invented by Bruns and Sauerbruch, was tested in the Zurich Clinic in 7 cases of bronchial ectasis of the lower lobe. Technically, the exposure and ligature of the artery, even in man, were not difficult. In all 7 cases, the form of the disease was diffuse bronchial ectasis, almost exclusively confined, however, to the left lower lobe. According to Schumacher's anatomic investigations[1] the topographic-anatomic conditions are especially favorable for the ligature precisely in the lower lobe. The first step of the operation was an intercostal incision

[1] Bibliography on the Anatomy of the Arteria Pulmonalis. Schumacher, Die Unterbindung von Pulmonalarterienästen zur Erzeugung von Lungenschrumpfung, Arch. f. klin. Chir., Bd. 95. Bullar, The Conditions of the Pulmonary Circulation, St. Bartholomew's Hospital Reports, London, 1892, xxviii, 257 to 262. Lheureux, M. Ch., L'arbre bronchique et les arbres vasculairs sanguins des pneumons, Lille, 1908. Rusca, Osservazieni sulla distribuziene della arteria pulmonale nel polmone umano. Belletine della soc. med. chir. di Pavia, 1913, xxvii, 55 to 62.

in the fifth intercostal area: in 5 out of 7 cases, there were loose pleural and interlobar adhesions, which were always easily severed with a dull instrument. The ligature resulted in exclusion of almost the entire lower lobe with exception of the apex, to which a special branch with higher ramifications leads; it was never followed by serious after-effects upon the circulation, much less upon the heart, and no clinical infarct symptoms appeared. In the two cases with free pleural sinus, postoperative pleural hemorrhages developed; in one of the 5 adhesion cases, once in the cavity there was a circumscribed hemorrhage; therefore it is advisable to confine the severing of adhesions to what is essential. In the clinical course, the following data were secured:

1. In the immediately following stage of fleshy transformation of the lung by connective tissue and of primary compression of the cavities: decrease, disappearance of the odor, and mucous transformation of the expectoration.

2. In the second stage, that of the callous and cicatricial shrinking of the lung transformed into connective tissue, there takes place, in many cases, apparently a new secondary eccentric dilatation of some cavities through centrifugal cicatricial traction; corresponding to this, there is increase in sputum, and heightened irritation that produces coughing.

In one case the ligature was followed by the closing of a previous bronchial fistula, in two others, by a distortion of the heart to the left side with cardiac dyspnea in exertion. A considerable shrinking of the ligatured lung always develops together with transformation of the lobe into a mass as large as a fist, containing little blood, and dryly crunching. Since the lung, unresisted and relaxed, should shrink as much as possible, the ligature should in every case be followed by an extensive thoracoplasty over the ligatured lobe. One patient showed extensive improvement approximating to cure with lasting decrease of the sputum from 120 to 20 c.c., another slight improvement with decrease of the daily sputum from 200 to 100 or 120 c.c.; two remained entirely unaffected; two others cannot be counted in estimating results, since the operation was performed only a few months

ago. The last patient succumbed when recourse was finally had to pneumectomy.

The operative preparation secured through pneumectomy made it clear that the lung in the peripheral areas which are poor in bronchi had been transformed into a fleshy callosity which contained isolated sacculated cysts; that the tissue of the lung had collapsed as far as possible, and had changed its rough anatomic and histologic structure beyond all possibility of recognition. The bronchi were pressed closely together, the non-cartilaginous ones being completely collapsed, while the incompressible cartilaginous ones had remained ectasied. In places the cartilage had become ossified.

These anatomic facts teach us that the efficiency of artificial shrinking of the lungs is limited by the anatomic peculiarity of the disease. Here, too, the large, rigid-walled and cartilaginous cavities remain virtually uninfluenced. The pressure of concentrically arranged cicatricial rings may, in the shrinking stage on this side of cicatricial stenosis in a few places cause a new stagnation, while the ectasizing and retraction of centrifugal cicatricial bands in single cavities may cause a still greater dilatation.

Our experience, then, leads to the following final conclusion: Considerable improvement in ectases, especially in those situated in the peripheral area of the lung; lack of success in incompressible, rigid cavities; especially those centrally located, no complete cure. The operation, not dangerous in itself, might therefore win a permanent place as preliminary operation in acute and subacute bronchial ectasis of pneumonic and empyematic origin; furthermore, as preliminary operation to a subsequent pneumectomy, since it firmly fixes the bronchus through cicatricial substance and so prevents its fatal rebounding into the mediastinum after the extirpation of the lobe has been completed.

The lancing and drainage of bronchiectatic cavities through pneumotomy is unquestionably regarded as the most natural method of treatment of circumscribed isolated cavities, or of

cavities consisting of many and large divisions, which are sacculated and sanious. Here, as is well recognized, and has been proved, the methods of treatment of chronic abscess of the lungs holds good; after circumscribed partial plastic over the area of the cavity, the bronchiectatic cavity is opened by one or two stages;

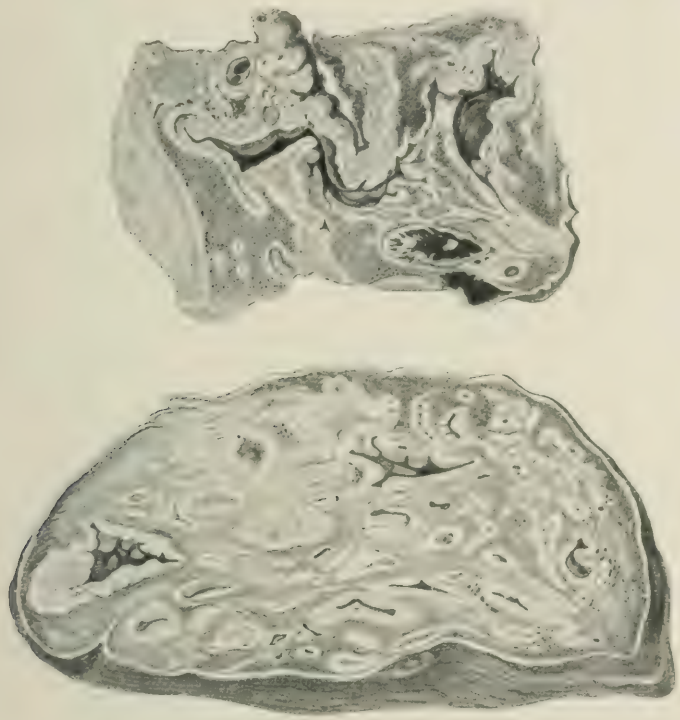

FIG. 4.—Bronchiectatic lower lobe after ligature of the arteria pulmonalis. Preparation through pneumectomy. Collapse of the uncartilaginous cavities and only insufficient collapse of the cavities stiffened by cartilage.

bronchial ectatic single cavities of the upper lobe here afford the best results; owing to the slighter development of the bronchi of the apex, the cavities here concerned are mostly but slightly rigid and quite capable of shrinking. Systems of cavities with many divisions that reach up to the hilum, are lanced, gradatim, by several stages. If in the peripheral areas of the lung there is an

extensive honeycomb system of ectatic cavities, the removal of a circular cortical area within a circle of deep sutures around it is advisable.

The mortality is astonishingly high. Out of fifteen patients, Körte lost eleven, 73.3 per cent. A computation of Bätzdorff shows a mortality of 62 per cent. as against only 9.4 per cent. of cures; one of Sauerbruch based upon 123 bronchial ectases treated by pneumotomy a mortality of 35 per cent., with 33 per cent. of cures; the remainder were not cured or only a little improved. The causes of death are edema of the lung, pneumonia, amyloid degeneration and weakness, abscess of the brain, hemorrhage, and peculiar shock-like deaths occurring during or immediately after the operation. In the neighborhood of sanious disintegrating bronchial ectases, endo- and periphlebitic processes take place in the area of the origin of the vena pulmonalis; small infected thrombi are slightly loosened by the operative process, thrown into circulation, and carried preferably to the brain. Aneurysmatic formations of branches of the pulmonary artery with severe, partly fatal hemorrhages, have been repeatedly recorded (Posselt, Chiari, Kümmell, Körte); the danger of a fatal hemorrhage that can scarcely be staunched is therefore particularly imminent in the incision of central cavities situated near the hilum. Hemorrhages from vessels imbedded in hard cicatricial layers, made rigid and held open by periarteritic processes, are often staunched only with great difficulty. These cases of death which occur a few hours after the opening of a cavity amid the rapid increase of most severe symptoms (cyanosis, cardiac weakness, loss of consciousness, hemiplegias, convulsions) are brought about anatomically by embolism caused by the entrance of the tiniest air vesicles from wide open, rigid vessels of the covering pulmonary tissue to vital centres of the brain.

Prophylactic measures would then be performing the operation with lower pressure procedure, operation at two different times, suture of damp tampons of gauze on the incised surface of the lung, finally making the incision into the lung within a circle of close and deep surrounding sutures. In that second group of fatal

cases in which death occurs suddenly and with shock during the operation itself, it is the matter of a pleural reflex the nature of which is as yet unknown; the centripetal path of this reflex seems to pass through the vagus, since severing of the main division of the vagus prevents the occurrence of this reflex. In my opinion, it would be worth while to test by experiment whether anesthetization of the exposed pleura of the ribs and lungs averts these fatalities.

Dangerous as the operation is, the degree of improvement after applying a pulmonary fistula is, at times, astonishing. Precisely in these forms of bronchial ectasis in which considerable stenosis of the efferent bronchi causes excessive congestion of the secretion, and thus constantly increases inflammation and ectasis, where ulcerous processes of disintegration and symptoms of severe septic-putrid intoxication appear, where there is general disease of the entire bronchial tree, which is steadily maintained and increased by the congestion of the secretion, in these forms, the creation of a place of exit for the secretion at the lowest point near the base of the lungs, in some cases is the only means of saving life. The mechanically poor drainage through the efferent air passages which is naturally made still worse by the presence of stenosis, must in these cases be replaced by a mechanically more efficient low-point drainage on this side of the stenosis. This does not, however, effect a cure, but occasionally it produces astonishing autopurification of the lung with disappearance of general septic symptoms and loss of the putrid character of the excretion. Quincke reports on the case of a patient who owed his ability to work to a bronchial fistula that had been with him for twenty-eight years. A subsequent extensive thoracoplasty will further strengthen and increase the purifying effect of the fistula.

Where the methods of preservation failed, extensive resections of the parenchyma of the lung or complete amputation of lower lobes thoroughly affected with bronchiectasis, served the purpose. These operations, in many cases successful, are difficult even when the organ is indurated and adhesive and shrunk by growth of

connective tissue. Technically, gradual ligatures *en masse* or removal by elastic ligature at the hilum are to be recommended. The shaky and usually very much reduced condition of the sufferer with chronic bronchiectasis makes these operations doubly dangerous. One of our patients who had been treated without any result with pneumotomy, plastic, and ligature, succumbed while this operation was performed. The ideal treatment of bronchial ectases strictly confined to one lobe, primary amputation of the lobe, is still, in cases with open pleural sinus, frustrated by the precariousness of the technique in regard to the occlusion of the bronchials; nearly all attempts ended fatally as a result of ligature decubities of the bronchial wall caused by tension-pneumothorax and mediastinal emphysema.

From combined operations, we have, up to the present time, not been able to secure any better final result.

If we take into consideration the results of all these operative methods, we cannot regard the outlook as very hopeful. Cure of old, rigid, genuine pulmonary suppurative and fully developed bronchiectases seems to be a Utopia, and according to the anatomic determinations of Quincke, Tietze, and Jehn, a thing of anatomic impossibility.

Essential progress must and can be secured by early operation and by application of our most effective methods of compression and shrinking in the early stages of the disease, in which collapse can be effected. Part of the failures are due to the insufficient mechanical devices of our previous methods. Furthermore, the most urgent problem that here demands solution, is the technical perfection of the closing of the bronchials after extirpation of the lobe.

Early operation is generally regarded as the most essential condition. But it will probably be realized only when practitioners in internal diseases and patients have changed their point of view in regard to this disease, as previously towards appendicitis. This is to be the more desired, since the dangers of plastic operation as well as of ligature are slight, even slighter

in early phases of the disease than in the late stages of bronchial ectasis when the heart and the kidneys are weakened.

For the compression treatment of bronchial ectases of the lower lobe alone, there seems to be some promise in a method which I have tested only, in experimenting upon dogs, a method which should, however, in my opinion, be applied as well in the case of men, without encountering serious scruples, namely, the displacement of the lower lobe under the diaphragm. This method connotes, to a certain extent, an exaggeration of Garrè's method of intrapleural displacement, so that we could expect here, clinically, as well as anatomically, more pronounced results.

Under different degrees of pressure the chest cavity is opened by an intercostal incision in the seventh or eighth intercostal areas and the thorax held open by the rib retractor. The diaphragm is paralyzed temporarily by means of stovain injection, or permanently by severing of the phrenic nerve right above its place of entrance into the muscle. Then an incision is made from the head of the ribs, radially, to beyond the middle of the epicranial aponeurosis. After that, the entire lower lobe is displaced through the opening in the diaphragm to a position underneath it, in the abdominal cavity, and the opening in the diaphragm is closed over the lower lobe by a series of button sutures with the exception of a small portion in the tendinous centre which barely lets the bronchus pass through. The suture that closes up the diaphragm begins in the tendinous arch near the place where the bronchus is severed. After reinflation of the remaining lung the intercostal incision is closed again by means of a pericostal suture and a two-layer suture of the soft parts. The operation, if the above technique is observed, is as successful on the left as on the right lower lobe. The subdiaphragmatically displaced lung, which is compressed fast between the diaphragm and the organs of the upper abdominal cavity, is pressed out like a sponge by the manner of its new location toward the bronchials, and succumbs, as histological investigations prove, to shrinkage and obliteration brought about by pressure, such as can be secured in an equal degree by no other method of operation known today.

In the experiment the lower lobe is, after two months, transformed into a no longer functioning, fleshy, thin disk, with trans-

FIG. 5.—Experimental subdiaphragmatic displacement of the right lower lobe. Condition about two months after the operation: lower lobe thin like a leaf, with loose adhesions of diaphragm and liver.

formation of the parenchyma into connective tissue, change and casting off of the bronchial epithelium and extensive oblitera-

tion and full compression of the respiratory apparatus. While, after ligature of the arteries, only the shrinking pressure of the connective tissue is felt, and in thoracoplasty, besides the elastic retraction of the lung into its relaxed position, only the compression exerted upon the outer surface of the lung is effective, and an opposing pressure in the inner side of the thorax is lacking or

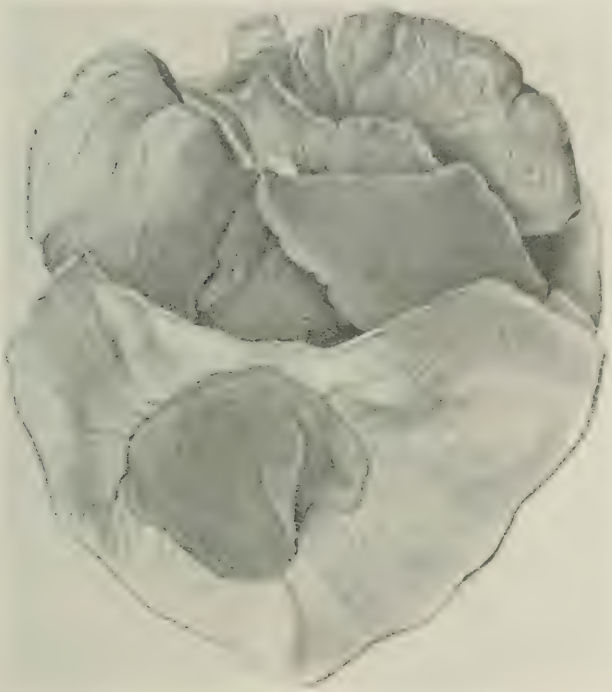

FIG. 6.—Experimental displacement of the left lower lobe under the diaphragm (dog). Condition of the displaced lobe, three and a half weeks after the operation.

not strong enough, the lower lobe that has been subdiaphragmatically displaced, is subject to a permanent compression from all sides. At the same time, the manner of its displacement excludes a subsequent new dilatation of large, non-isolated, bronchial lumina by means of centrifugal cicatricial retraction, and the

lower lobe remains permanently excluded from functioning and removed from the inspiratory suctorial power of the thorax. That fatal retraction effect at the pulmonary hilum, which was observed by Sauerbruch in an experiment for extracostal displacement of a pulmonary lobe, that sudden decrease of the blood-

FIG. 7.—Histological picture of the lower lobe about two months after subdiaphragmatic displacement. Lung mostly of a fleshy consistence through perivascular, peribronchial, subpleural, and interstitial growth of connective tissue. Minor and medium bronchi obliterated, the major ones twisted like corkscrews.

pressure and the temporary cessation of breathing which Friedrich describes in a case of strong drawing forward of the hilum of the lung into the chest wound with concomitant flexion at the hilum, never occurred in my experiments.

In early cases, if the pleura were free or in the presence of easily severed adhesions, the displacement of a bronchiectatic lower lobe under the diaphragm might be a possible and promising operation also upon human beings.

Will you permit me to make another suggestion in regard to the operative technique in extirpation of entire pulmonary lobes? The problem of a secure hermetical closing of the bronchial stump is the nucleus of all attempts at a radical ideal treatment of circumscribed bronchial ectases of pulmonary lobes. When the bronchial tube is of wide caliber and stiffened with cartilage, all methods of ligature, those of Tiegel and Friedrich as well as the invagination method of Willy Meyer, lead to ultimate cutting of the thread. In order to avoid this, two technical possibilities may be suggested:

1. By means of intercostal thoracotomy a sufficiently long and broad fascial lobe, which is to be taken from the outer side of the fascia lata of the thigh, is sutured round about the bronchus and the neighboring surface of the lung with finest silk thread, so that, like a cricoid ruff, it covers the bronchus, and within a large radius the adjacent surface of the lungs. After ingrowing of this fascial collar, a few weeks later, by a second thoracotomy, the lobe from this fascial covering is taken out and excised; meanwhile, a hilum forceps constructed on the Doyen clamp principle, compresses the bronchus near the hilum, in order to prevent expectoration during the operation. Curetting of the mucous membrane of the bronchial stump follows, whereupon the fascial ruff which is firmly intergrown with the stump is pushed partly upward into the bronchial tube up to its point of departure, but its main part is closed by a series of sutures, one after the other, over the stump

2. A similar organic occlusion and plugging of the bronchial stump may be secured by inserting, after curetting the mucous membrane, a stopper of adipose tissue or of fascia rolled together to close the stump and a series of button sutures, one behind the other, serve for fixation of this organic stopper. In my opinion the avoidance and total exclusion of blind tube portions are of supreme importance; by this means alone the inspira-

tion into the bronchial stump can be prevented; no less important is the performing of the operation in a low-pressure room, since the reinflation of the lung mechanically puts the resistance of the closure to too severe a strain.

SUMMARY. 1. Inflammatory and fetal atelectatic bronchiectases are the surgical forms of ectasis in a restricted sense. A considerable proportion of the former develop, probably, upon the ground of congenital and hereditary organic weakness.

2. From the point of view of treatment, one must distinguish between the central, parahilous and rigid wall, and the peripheral, soft-walled bronchial ectases.

3. The former are wholly impervious to operations for relaxation and compression. The latter may, especially if they are of pneumonic or empyematic origin, be brought through extended thoracoplasty, not to complete cure, but to improvement, more or less approximating cure. The pneumothorax treatment has failed with all forms of bronchiectasis.

4. The ligature of lobe branches of the arteria pulmonalis combined with partial plastic operation produces gradual shrinking of the lung to a still higher degree. Yet permanent cures have not been reached even in this way, though extensive improvement has been attained.

5. In cases of primary affection of the bronchial system and in all central forms these conservative operations are total failures. Their significance, however, lies in the fact that in these cases they prepare for and make less dangerous the only correct operation, resection or extirpation.

6. Intrapleural displacement of the lower lobe, too, according to Garrè, effects only extensive improvement, but no permanent cure.

7. Circumscribed, single cavities, or large cavities with several divisions, can be improved and occasionally even cured through pneumotomy.

8. Considerable progress is to be expected in earlier stages of the disease through operations, with the use of mechanically more efficient methods of compression (subdiaphragmatic displacement of the lower lobe) and with perfection of the technique of excision of the lung.

TABULATION OF CASES OF BRONCHIECTASIS TREATED WITH LIGATURE OF THE ARTERIA PULMONALIS.

No.	Sex.	Age.	History.	Operation.	Result of operation.
Case 1	M.	34 years	Metapneumonic empyema of the left lower lobe. Daily sputum 50 to 80 c.c. Sputum malodorous, containing elastic fibers. Diagnosis: gangrene of the left lower lobe.	August 7, 1910. Pneumotomy.	Disappearance of acute septic symptoms.
				November 4, 1910. Thoracoplasty.	
				December 8, 1910. Ligature of pulmonalis.	After 21 months no decided improvement. Sputum 120 c.c. odorless.
				September 7, 1912. Pneumectomy of the left lower lobe.	Death consequent upon the operation.
Case 2	F.	38 years	Probably congenital bronchiectasis of the left lower lobe. Internal treatment for years, all in vain. Sputum, 400 to 500 c.c.; sanious.	April, 1910; August, 1910. Thoracoplasty.	Aspiration pneumonia of the right lung. No improvement. Sputum, 300 to 400 c.c.
				January 27, 1911. Ligature of the arteria pulmonalis, intrapleural severing of the heart adhesive to the wall of the chest and drawn to the left.	Sputum temporarily decreased to 160 c.c.; later again 380, sanious. Cardiac action improved by the intrathoracic cardiolysis. Lowering of frequency of pulse from 140 to 80 to 100.; Death from suicide 3 months after the operation.
Case 3	M.	22 years	Metapneumonic bronchial ectases of the lower lobe. Two attempts of pneumothorax futile. Sputum, to 210 c.c.; malodorous, occasionally with blood, three layers. Left side of the chest very flat. Inability to work.	November 15, 1911. Ligature of the pulmonalis, pleura considerably thickened, partly adhesive.	Appearance of an infected pleural exudation (anerobic cocci, Gram-positive and Gram-negative bacteria) drainage.
				December 13, 1911. Thoracoplasty (3 to 9 ribs).	Severe collapse of the thoracic wall. No improvement. Quantity and quality of sputum as before the operation.
Case 4	M.	49 years	Bronchial ectases of the left lower lobe after influenzal pneumonia (1908). 1909 frequent hemoptysis. Treatment in sanitarium for 4 months on suspicion of tuberculosis. 1910 recurring copious hemoptysis. Inability to work. General condition poor. Sputum 100 to 120 c.c., very malodorous, three layers containing blood.	December 12, 1911. Ligature of the pulmonalis. No adhesions.	Sputum 150 to 200 c.c., free from blood, less malodorous. Serous hemorrhagic sterile postoperative pleural exudation.
				February 21, 1912. Extensive thoracoplasty (4 to 10 ribs).	May, 1912. Bronchopneumonia in the right lower lobe. Increase in weight June, 1912. Sputum 70 to 80 c.c. 11 months after ligature of the pulmonalis sputum 20 c.c., free from odor. Ability to work. April, 1911. Sputum 20 to 30 c.c. Temperature normal. September, 1911. Suddenly copious hemoptyses. November, 1913. Sputum, 40 to 60 c.c.
Case 5	M.	18 years	Metapneumonic bronchial ectases of the left lower lobe. 3 pneumonias before the age of 16; pleuritis twice in the 17th year. Since the 16th year sputum almost free from blood, malodorous, 200 c.c., three layers, without elastic fibers.	January 31, 1912. Ligature of the pulmonalis.	February 8. Small postoperative pleural exudation. April, 1912. Sputum 20 to 40 c.c. May, 1912. Sputum 100 to 160 c.c.
				May, 15 1912. Extensive thoracoplasty (2 to 11 ribs); severe collapse of the chest wall.	December 9, 1912. Sputum, 80 to 120 c.c., slightly malodorous. November 28, 1913. Condition unchanged. Sputum, 100 to to 120 c.c., mostly malodorous, occasionally containing blood. Ability to work. High degree of contraction of thorax. Heart covered by the left upper lobe.
Case 6	F.	24 years	Metapneumonic bronchial ectases of the left lower lobe. Pneumonia at age of 6 months; since then coughing, yellow-green expectoration, tendency to acute catarrhs. 1913 treatment in Davos. Temperature normal. No tubercular baculi in the sputum. Test for tuberculosis negative. No perspiration. Postdiphtheritic paralysis of the vocal cords. Nontubercular proliferations of both vocal cords. Sputum 25 c.c. purulent.	August 28, 1913. Phrenicotomy.	Increase in weight. Sputum, 35 to 90 c.c.
				October 4, 1913. Ligature of the arteria pulmonalis.	October 28, sputum, 50 to 60 c.c. December 2, sputum, 60 to 90 c.c., purulent. Severe irritation of the throat causing cough.
				December 17, 1913. Thoracoplasty (5 to 11 ribs).	Skiagram: left diaphragm, 1 to 2 fingerbreadths higher. Heart displaced.
Case 7	M.	24 years	Bronchiectases of the left lower lobe. Sputum up to 75 c.c., slightly malodorous, once profuse hemoptysis.	November 27, 1913. Ligature of the arteria pulmonalis.	December, 1913, sputum, 100 c.c.; January 24, 1914, sputum, 25 to 35 c.c. Healthful appearance.

ON BRONCHIECTASIS

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Bronchiectasis is a disease of the bronchial tree, *not* of the pulmonary parenchyma. Formerly belonging entirely to the domain of internal medicine, it has, within the last decade, together with many other affections, entered the borderland and is at present a subject of general inquiry. Particularly among surgeons has its treatment created widespread interest. Laryngology, too, has added its possibilities to the various other means at our disposal in the fight against this hydra-headed and torturing disease; and medical technique has given us a device which lends further assistance. With the multiplication of the points of attack, we can say that the near future seems to hold out greater hopes for a complete recovery to the unfortunate individuals afflicted with this chronic ailment, a disease, in which, so far, the combined efforts of all the medical specialties concerned have been able to achieve improvement only, but no cure.

The literature on the subject shows that the surgical treatment of bronchiectasis dates back to 1873, when Mosler proposed the incising and draining of a bronchiectatic cavity. Later, Lenhartz, Quincke, Garré, Körte, Tuffier, Brauer, and others devoted much thought to the disease and furthered its treatment in original ways. The pathologists, too, have added their share, of late, particularly Aschoff (still unpublished). In 1911, Sauerbruch read an article before the International Surgical Congress at Brussels, the most comprehensive review

of the subject so far published; in the course of this paper it has been repeatedly quoted.

In the English language, to my knowledge, there exists no exhaustive treatise on bronchiectasis. It appeared worth while, therefore, to review what is known about the disease and its therapy in all its phases—pathological, medical, and surgical. Only the absolutely essential will be mentioned. For the sake of conciseness, names of authors have been omitted as much as possible.

Pathological Anatomy. Bronchiectasis, distention of the bronchi, is either diffuse (cylindrical) or circumscribed (sacculated, spindle-shaped—rare—or of varicose appearance).

The diffuse variety is of pathological interest only and often shows the disease but slightly developed. It is recognized by the fact that at autopsy the bronchi can be divided with scissors almost to the pleural covering of the lung, particularly in the lower lobes.

Circumscribed bronchiectasis is found singly or multiple. It is the usual type met with clinically. Not infrequently the cavities are so numerous that a cross-section of the lung in places resembles a honeycomb.

The size of the cavities in the adult varies from that of a bean to that of a hen's egg. In very small children they have been found as large as a pea.

The afferent bronchus usually enters the distended portion quite abruptly, rarely in a gradual way; not infrequently it is strictured just in front of it.

The cavities contain a mucopurulent, often fetid secretion. If the latter becomes very thick, lime salts may be deposited in it, so that incrustations the size of a cherry pit and larger, so-called broncholiths, are formed.

The mucous lining of the bronchiectatic cavities is invariably in an inflammatory condition, sometimes the walls are hypertrophied and villous. This hypertrophy may involve all the layers of the wall, mucous glands, muscle and elastic fibres, cartilage and peribronchial tissue, while in other places the wall may

appear smooth or irregularly striped, its just enumerated normal elements having more or less disappeared and connective tissue taking their place. The epithelial lining is missing, as a result of atrophy and cicatrization. Thus atrophic and hypertrophic portions of the bronchial wall may be found in closest proximity. Often lime salts are deposited in the pathologically changed tissues, particularly in the cartilage. The distal end of the diseased bronchus may become obliterated; adjoining cavities may become confluent owing to atrophy of the dividing walls.

The disease is sometimes found in the middle lobe of the right lung, but most frequently in the lower lobes of either side. Tuffier saw it in the latter in forty out of forty-five cases. Both lungs may be affected at the same time. Men are, by far, oftener afflicted than women. A predisposition as to a certain time in life for the development of the disease does not exist.

Etiology. Bronchiectasis may be congenital as well as acquired.

If congenital, the whole lung, or a portion of it, presents a great many small cysts with very thin walls, filled with a watery or mucoid fluid, a condition which most likely is due to an arrested development, no alveoli having formed in the affected parts, but only larger bronchi in increased abundance. Another explanation is congenital (fetal) pulmonary atelectasis, the latter preventing the proper development of the growing bronchial tree.

Some of these patients with congenital bronchiectasis are known to have reached old age (sixty-five years).

If acquired, various causes may bring it on. Bronchiectatic distention may develop in the distal portion of the tubes, if the bronchial wall is compressed from within (ecchondrosis) or from without (aortic aneurysm). The bronchi then distend to irregular sacculations, containing many cartilaginous rings and mucous glands; the interposed parenchyma of the lung gradually atrophies (atelectatic bronchiectasis).

Another type is represented by compensatory distention of the

bronchi, in case of shrinking and thickening processes in lungs and parietal pleuræ, and can be best observed in patients who have been operated upon for empyema following acute pneumonia after the visceral pleura has become thoroughly adherent to the parietal. This explanation of the occurrence of the disease is supported by experiments made by Sauerbruch in conjunction with Bruns, which showed that ligation of branches of the pulmonary artery produces connective-tissue hyperplasia and extensive adhesions between visceral and parietal pleura. After some time marked dilatation of the bronchi was found in these animals, a phenomenon which cannot be explained otherwise than by traction of the shrinking connective tissue in the lobes of a lung which is adherent to the chest wall.

The most frequent cause of bronchiectasis is *chronic* inflammation.

In childhood measles, whooping cough, and influenza represent predisposing causes; the symptoms then increase with advancing age. If the disease develops later, it is usually the consequence of primary inflammation of the bronchial wall itself whereby its strength is weakened; or it is consecutive to inflammatory processes of pleura or lungs.

Other predisposing causes are harmful effects due to occupation, extravagant use of alcohol and tobacco, and irregular habits.

The pathological sequence of the phenomena has not yet been definitely made out. It is possible that increased intrapulmonary pressure, as it occurs in singing, screaming, persistent coughing, may gradually produce permanent distention of a weakened portion of the bronchial wall, all the more if some parts of the lung are unduly taxed on account of disease of other parts and the latter's consequent inability to do their share of the work.

However, circumscribed cavities certainly develop oftener, if in the presence of inflammatory changes the bronchial tube becomes bent or stenosed, so that the mucous secretion is not properly drained off and gets a chance to accumulate. The

secretion then becomes mucopurulent or purulent and, through the working of bacteria, decomposed (putrid bronchiectasis). Unhealthy looking ulcers develop, which gradually involve the wall of the bronchi and produce gangrenous inflammation of the neighboring lung tissue. Severe hemorrhages may occur by erosion of bloodvessels, particularly if the latter, too, are found distended, either uniformly or in the shape of small aneurysms. In other places, where the secretions can be better drained off, easily bleeding granulations spring up, which often tinge the expectoration with blood. These granulations gradually destroy the longitudinal bands of the elastic fibres which, not unlike a continuous rubber band, are found distributed throughout the entire bronchial tree. They often also destroy the muscular fibres of the bronchial tubes. According to Aschoff, this destruction of the elastic longitudinal ligaments (Längsbänder) is the principal causative factor in the development of bronchiectatic cavities. The same kind of destruction occurs in the development of aneurysms. With the latter bronchiectasis can be best compared (private communication). The inflammatory process invariably spreads to adjoining healthy portions of the bronchial tree in which ectases have not yet developed. If the foul secretions are aspirated into such parts of the lung, lobular catarrhal pneumonia develops. In other instances the bronchi may become more and more stenosed, sometimes even obliterated, thus interfering with proper drainage. The formation of a lung abscess is the consequence.

On the other hand, secondary affection of the adjacent lung parenchyma, or secondary atelectasis, may also produce fibrous thickening of the lung tissue, with compensatory emphysema. If the foci are near the surface of the lung, pleural adhesions, too, will form, establishing thus a typical vicious circle.

If the bronchiectatic cavity becomes entirely encapsulated, a cyst of the lung may develop; its contents may become thickened through absorption and gradually solid through salt deposits; this represents another mode of broncholith-formation (see above).

In one instance has the aspiration of a foreign body, which remained *in situ* unrecognized for a long period (a few years) been the etiological factor of producing bronchiectasis with voluminous expectoration of a fetid sputum. (Knoepfelmacher, *Münch. med. Woch.*, 1912, p. 1132.)

Symptomatology. In the beginning of the disease the clinical symptoms are often rather insignificant. The paroxysmal cough with purulent expectoration is usually taken by the patient for a pharyngeal or bronchial catarrh, and he hardly ever consults a doctor until the sputum becomes admixed with blood and of foul odor and taste. Coughing spells set in, as a rule, when the patient changes his position; they also occur at irregular intervals during the day in the midst of quiet occupation, or during the night while sleeping. Many patients are able to expectorate at will. The sputum is abundant and fills the mouth of the patient faster than he can get rid of it; the procedure is more like a vomiting spell. The odor of the sputum frequently is exceedingly foul, so much so that the patients become a burden to their families and to themselves. In institutions it may become necessary to isolate them. Not infrequently blood is admixed with the sputum. Serious attacks of hemoptysis have repeatedly been seen.

The collected sputum presents the well-known three layers. In the lower one, nodular masses (Dietrich's Pfroepfe) may be found. Microscopical examination reveals a large amount of pus corpuscles in all stages of disintegration, fat globules, needles of margarine acid, and an array of bacteria. Elastic fibres are rarely seen, but whole pieces of gangrenous lung tissue are not infrequently coughed out.

In general, these patients do not feel very sick; few have dyspnea. However, they make the impression of people who are chronically ill. Children and younger individuals appear undeveloped and anemic. When the sputum has become putrid, septic fever and night sweats set in. As a rule, the tips of the fingers and toes are club-shaped. The entire picture greatly resembles that of pulmonary tuberculosis. Many of

these patients are found in sanatoria for consumptives; tubercle bacilli, however, are never demonstrated in the sputum.

Diagnosis. In view of the character of the symptoms above enumerated, it is but natural that many errors in diagnosis occur, and as a result the medical man often witnesses pathetic scenes. Thus one of my own patients, a young married woman of the laboring class, had become separated from her husband, because the district nurse insisted that she had pulmonary tuberculosis. The husband kept the two children and she was sent to a sanatorium for tuberculosis. Having been discharged from the latter, she went to live with her mother. Later, after the definite diagnosis was established, a proper explanation of the true state of affairs to both parties reunited the couple.

The diagnosis certainly is not easy, at least not in the early stages of the disease. Most frequently it is confounded with tuberculosis or purulent bronchitis. Continued careful observation will gradually reveal the true condition.

In the later stages pulmonary abscess or pulmonary gangrene from other causes, fetid bronchitis and empyema with perforation into the bronchial tree, come into consideration as regards differential diagnosis.

Our usual methods of physical examination often fail to render reliable assistance. On percussion, a few dull or tympanitic spots may be made out over the lower and middle lobes, usually on one side only, according to the extent and degree of retention of the secretion within the cavities and the patient's posture. If much peripheric sclerosis of the lung tissue is present, dulness may be well marked. On the other hand, all these signs may be absent or indistinctly developed. In one of my cases, that of a young man of twenty-five, percussion did not reveal the slightest tangible assistance toward diagnosing and localizing the disease.

The same is true of auscultation. We hear soft crepitant as well as louder sonorous râles at various places, particularly over the posterior and lower part of the chest, when there is sputum

present in the cavities; we hear amphoric and bronchial breathing here and there after thorough expectoration.

The fact that these auscultatory findings are not infrequently transmitted, and well audible over the unaffected side, makes the diagnosis on *this* basis extremely difficult. Still, on close and repeated examination, the quality of the sound, in conjunction with distinct circumscribed bronchial breathing, will guide us in properly localizing the trouble.

The history of the case also will here render useful assistance. Some patients have had frequent pain in one side of the chest only, sometimes accompanied by fever, most likely the clinical expression of localized pleuropneumonia with consequent adhesion formation—or they have gone through a severe attack of unilateral pneumonia at one time or another of their life, which marks the starting of their trouble. This was the history in almost every one of the cases I have observed and has been found to be a most valuable aid in rendering the diagnosis.

The vocal fremitus shows no characteristics in this trouble.

Radiography, too, this most valuable factor in establishing the correct diagnosis in thoracic disease, particularly when done stereoscopically, is of comparatively little value in bronchiectasis. All authors agree that it is not safe to place too much faith in the shadows of the *x*-ray plate in this particular trouble. The extent of the disease can hardly ever be made out with its help. In one of my patients the rosary-like condition of the early subdivisions of the main bronchus was beautifully demonstrated.

Inasmuch as it has been shown of late that the injection of a few ounces of antiseptic fluid into the bronchi in the shape of a spray or small stream is well borne, without the occurrence of an aspiration pneumonia, I would propose and soon expect to try insufflation of collargol into the depth of the trachea and bronchi after the patient has thoroughly expectorated. In this way we may perhaps enable the radiographist to show more distinctly the contours of the walls of the distended bronchial

cavities, just as is the case in urological surgery with pyelography (see below, under treatment).

Aspiration with needle and syringe is not recommendable. But *in the course of operating* (pneumotomy) the aspirating needle is the guide to reach the cavities.

A review of these brief remarks might lead one to ask quite properly: How then can the diagnosis of bronchiectasis ever be made? The question would be justified if our daily routine of clinical examination were our only means for reaching a diagnosis. But we have the history of the case as a guide, also the well-known method of exclusion to aid us in establishing the diagnosis.

In general it can be said, that patients suffer most likely from bronchiectasis who are expectorating quantities of mucopus or pure pus, sometimes mucus with streaks of, or with larger quantities of, blood, following paroxysmal attacks of coughing, who complain of night sweats and fever and show the clubbing of fingers—in short, patients with all the well-known subjective symptoms of pulmonary tuberculosis, but with a continued negative result as to tubercle bacilli. That probability is increased by the foul odor and taste of the sputum and by the development of the disease in the trail of a pneumonia which was caused by aspiration or otherwise. More precise points must then be brought out by daily clinical examination.

The real difficulty lies in making the diagnosis in the incipiency of the disease. Further knowledge is required to enable us to render a definite diagnosis in the early stages of the trouble. For in this disease, as in so many others, the early diagnosis is the keynote for a satisfactory result of our therapeutic measures.

Course. The course of the disease is chronic. Death is oftener due to complications than to the trouble itself. Strange to say, not a few patients die from abscess of the brain, sometimes also of the cord, or very acute suppurative meningitis. Tuffier lost 6 of his 45 patients from brain abscess. I had three deaths from acute suppurative meningitis in my ten cases. The symptoms of the latter disease were unmistakable in my patients,

although I was unable to obtain an autopsy to corroborate the clinical diagnosis. The cause of this affinity of the septic bacteria for the cerebrospinal system is not yet known. It certainly cannot be looked upon as a simple septic metastatic process. Thoracic infections seem to have a tendency to secondary acute inflammations of the central nervous system. In 1888 I reported a case of internal esophagotomy in a child that developed acute meningitis, followed by death, five days after operation. Professor Aschoff, of Freiburg, has the following to say about this peculiar phenomenon:

"Regarding the appearance of brain abscess in bronchiectatic suppuration, we are unfortunately not able to give a plausible explanation. We only know that the bronchial secretion contains myeline substance in abundance; bronchial and alveolar epithelia have the tendency to produce myeline of a special kind, as has been shown by Virchow. It might be possible that in consequence of this the microörganisms of the bronchial secretions, whenever they enter the circulation, gain a predilection for the central nervous system which is so rich in myeline. On the other hand, it is well known, and I personally have seen cases of carcinoma in the bronchial tree, in which metastatic cancerous elements were directly transported—by way of the costal lymphatics—into the subdural space and the meninges. In view of this, it may well be possible, that in the case of bronchiectasis or pneumonia, the meninges of the cord and brain become infected by way of the lymphatic vessels. Perhaps also the special class of microörganism might come into consideration. It is well known that pneumococci, and those related to this type, have a great tendency to infect the meninges as well as the brain itself, *e. g.*, otitis media, meningococci, etc." (Private communication.)

That pneumonia and gangrene may set in, has been mentioned above. Pulmonary hemorrhage, although sometimes severe, has rarely been the cause of death (Kümmel saw one case).

Perforation of a bronchiectatic focus into the pleural cavity with the prompt appearance of an acute pyopneumothorax has

been fatal in every instance (Körte, four cases; Küttner and Sauerbruch, one each).

The chronic suppuration and absorption of toxins produce amyloid degeneration of the kidneys and other parenchymatous organs, also myo- and endocarditis; the disturbance of the pulmonary circulation may cause dilatation of the right ventricle and weakness of the heart.

Toxin absorption with entrance of bacteria from the fauna, always present in the bronchiectatic cavities, by way of lymph- or bloodvessels, may give rise to painful recurrent joint affections in milder cases, or to the development of liver abscess and general sepsis.

Heidenhain observed one case of cancerous degeneration of the lung as a result of an old bronchiectatic affection.

Treatment. Today it is generally recognized, that a somewhat advanced, viz., a well-developed, bronchiectasis is a surgical and not a medical disease. *After* operation, internal medicine, laryngology, and surgery join hands. Hygienic régime of any kind, and open-air treatment so helpful in tuberculosis, are powerless in this affection of the bronchial system. An active therapy becomes imperative as soon as the diagnosis has been made. That milder, non-operative methods will be most effective, if brought into play early, stands to reason. That, however, implies "early diagnosis," the great difficulties of which have been dwelt upon above. Yet, there can be no doubt that progress will soon be made also in this respect, and the efforts of all interested should be bent in this direction. By means of frequent publication the attention of the profession should be called to the necessity of careful differentiation in the diagnosis of pulmonary diseases. Particularly should it be pointed out that the persistent absence of tubercle bacilli, in the sputum of patients whose trouble otherwise makes us think of the presence of a tuberculous affection, clearly points to bronchiectasis, and that it means—to say the least—loss of time to those individuals to be sent to a sanatorium for consumptives. The particular variety of bacteria with their

toxins in the blood of these patients evidently and fortunately seems to counteract the entrance of the tubercle bacillus into the system. Otherwise it cannot be understood why these patients, offering so many opportunities for the entrance of the bacillus, particularly when detained in sanatoria, should not develop tuberculosis as a complicating disease. Yet, this, it seems, has never been observed.

As matters stand today, the majority of the patients are treated on general principles for many years, before active local and operative measures are employed. They are usually referred to the surgeon when all the advanced symptoms, enumerated above, have fully developed, when the elastic fibres within the walls of the many cavities have been totally destroyed and calcareous deposits have transformed them into unyielding "cesspools." The difficulty of establishing a strict diagnosis is ostensibly the principal cause of the fact, that these patients are referred for proper treatment in an advanced stage of the disease.

The second contributive cause for the usual delay is to be found in the unsettled condition, up to the present time, of the proper development of therapeutic measures and particularly of operative interference. However, the indication for the various procedures is rapidly becoming clarified, and the very near future is bound to see a great advance in this respect. Specialists everywhere have become interested in the disease. The old lethargy is rapidly disappearing and giving way to a clear conception of what is best suited in the individual case. Nevertheless, as long as the operation so far devised cannot show definite and permanent cures, and the radical ones must still be considered as very dangerous, it is to be expected that patients whose bronchiectasis has been diagnosed in the earlier stage, will not readily give their consent to the performance of such operations. On the other hand, the statistics of these operations will improve as soon as a greater number of surgeons working along these lines, have had an opportunity of operating in the earlier stage of the disease.

Körte, a few years ago, formulated the indication for operation in these cases by stating that "these patients must be operated upon, (1) as soon as the putrefaction of the secretion within the cavities has made them socially impossible; (2) in the presence of serious complications, the latter comprising fever, night sweats, recurrent attacks of aspiration pneumonia, severe hemorrhages, cachexia."

In the light of the progress made within the last years, these indications will soon be radically modified, in fact, they have already been extended, inasmuch as the necessity of aggressive treatment also in the early stages of the disease has been recognized.

At the present time, in early cases, the treatment should be carried out progressively, *i. e.*, beginning with milder measures, carefully observing their effect, and, if unavailing, resorting to more and more heroic treatment, finally resorting to one of the various intrathoracic operations devised. In advanced cases the latter have to be considered from the start. The only drawback at the present moment is the difficulty in selecting an operation which is effective and does not involve too great risk. For it will have to be the surgeon's task to show a low mortality in these operations. Only in this way can the absolutely necessary confidence of profession and laity in thoracic work of this chapter be gained, and wholesome progress be guaranteed.

Briefly reviewing what is known to us in the way of useful active therapy in bronchiectasis today, one may classify as follows:

I. *Non-operative Treatment:*

a. By way of the alimentary canal—thirst cure.

b. By way of the circulatory system—intravenous injection of colloidal silver.

c. By way of the respiratory system—(1) inhalation of superheated air with admixture of suitable drugs; (2) direct intrabronchial application of drugs per syringe or spray.

II. *Operative Treatment:*

a. Extrapleural—(1) thoracoplasty; (2) pneumolysis.

b. Intrapleural—(1) therapeutic pneumothorax—insufflation of nitrogen; (2) incision of lung—pneumotomy; (3) transposition of lung by means of suture fixation; (4) ligation of branches of the pulmonary artery; (5) extirpation of the diseased portion of the lung.

c. Intrapericardial ligation of either main branch of the pulmonary artery (still in experimental stage).

d. Diaphragmatic—paralyzing one side of the diaphragm corresponding to the diseased lung by resection of the phrenic nerve at the neck (phrenicotomy).

The operative treatment should also be considered from the following points of view:

A. Pneumotomy for draining the suppurating cavities.

B. Operations done to compress the lung (collapse-therapy). (1) By creating therapeutic pneumothorax—nitrogen insufflation; (2) pneumolysis with or without introduction of a plomb; (3) thoracoplasty, combined with, or without (4) phrenicotomy.

C. Operations done to influence the pulmonary parenchyma, producing contraction plus carnification. (1) Transposition of the lung; (2) ligation of branches of the pulmonary artery, with or without subsequent thoracoplasty, pneumolysis and phrenicotomy—intrapericardial ligation of the first divisions of the pulmonary artery.

D. Amputation of the diseased lung.

The latter subdivision is referred to below.

I. Non-Operative Treatment. *a. Thirst cure:* Singer (*Wiener. med. Woch.*, 1913, N. 24) recommends a systematically carried out "thirst cure" in order to reduce the amount of expectoration in bronchiectatic patients. The total amount of fluids allowed within twenty-four hours is slowly decreased to 200 c.c. Two "wet days" a week with 1200 to 2000 c.c. of fluid are interposed. Sweat baths, gradually added, produce further reduction of the quantity of the sputum. The

use of chewing tablets, lime preparations internally on account of their anti-inflammatory effect, and inhalation of oxygen, are valuable aids in this heroic treatment. Singer publishes eight cases showing the good results obtained with this thirst cure. I am at present testing it in one of my own patients, but am not yet ready to report.

b. Intravenous injection of colloidal silver (*electrargol*), in early cases of localized bronchiectasis and pulmonary gangrene, is mentioned merely for the sake of completeness. Only one case reported (*Fortschr. d. Med.*, 1913, p. 757). First collargol-solution 0.1 per cent., tablespoon doses, given repeatedly per os for two weeks, to stop vomiting, caused by swallowed fetid sputum. Then electrargol intravenously (18 injections of 5 c.c. each in ampoules), every second day. Temperature dropped, sputum decreased, no longer mixed with pus. General condition improved.

c. (1) *Inhalation of superheated air with an admixture of suitable drugs:* In the spring of 1913 I had at one time five patients with bronchiectasis under my care; three males and two females. The former had been operated upon previously by me with ligation of branches of the pulmonary artery. Two of them returned to have secondary thoracoplasty added. The two females were yet to be operated upon. Just then Elsaesser published his paper on the beneficial effect of superheated air inhalation for certain affections of the respiratory system.[1] He employed the well-known electric hot-air douche, called "Foen," which he supplied with a device for admixing suitable drugs to the hot-air current. The same idea had been tried as early as 1888 by Weigert and Halter,[2] and they claimed to have obtained good results in lung tuberculosis. Of late a number of others have investigated its effect. Thereby encouraged, I induced some of my patients to try it. Three of these patients soon got tired of using the inhalation. One saw no improvement and later died of acute suppurative meningitis; one, who had

[1] Deut. med. Woch., 1911, p. 116.

[2] Berl. klin. Woch., 1888.

the branch of his pulmonary artery tied, has faithfully continued the use of the medicated hot-air current for the past year and is very much improved. The method seems to deserve recommendation in conjunction with surgical therapeutic measures.

(2) *Intrabronchial applications of drugs by means of catheter with syringe and spray:* This method goes one step further than the preceding one. Useful drugs are applied directly where their application is desired. This treatment dates back to 1904, when Jacob, Bongert, and Rosenberg published their experience and clinical studies which they had made at the Clinic for Internal Medicine at the Berlin University. They used a catheter which was passed through the glottis into the trachea. In 1910, Ephraim described his ingenious device for intrabronchial spraying[1] (see Figure), and last year, Guisez published his method of injecting drugs,[2] very similar to that of Ephraim. Under the guidance of the laryngeal mirror, a long, curved cannula is passed into the lower trachea and 20 to 25 c.c. of the medication are injected by means of a syringe. He asserts that the entire pulmonary parenchyma becomes permeated with the fluid within a few minutes.

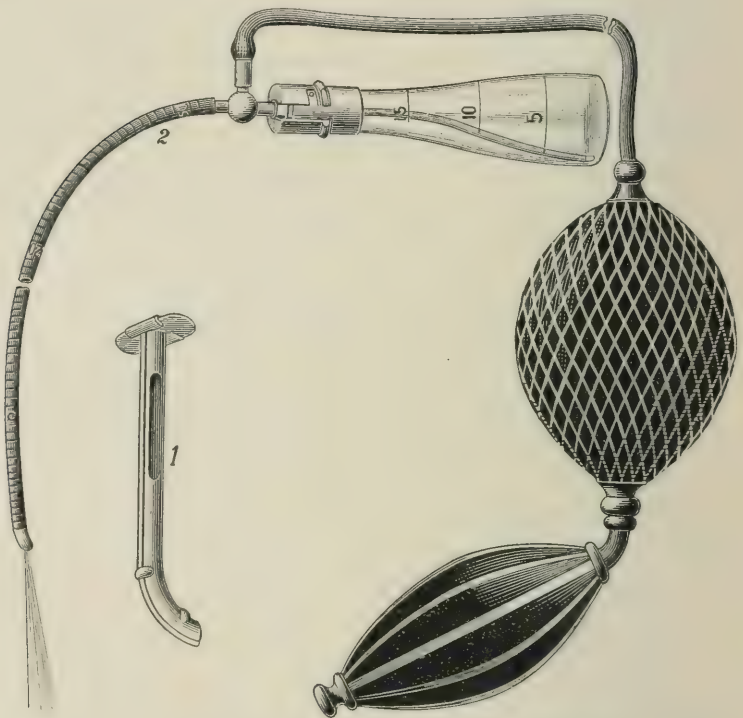
These methods have not yet received the recognition they seem to deserve. It will be necessary for the laryngologist to acquire the technique and join hands with the internist and surgeon in combating some of the symptoms of this Proteus-like disease. However, these non-operative methods can be of lasting benefit only when applied in the beginning of the trouble; it is clear that they cannot influence or improve the pathological changes of the walls of the bronchi. In the more advanced cases they can, therefore, play but a secondary role, that of adjuvants to operative treatment.

As stated above, collargol with its strongly antiseptic qualities might be made use of to advantage for such intrabronchial application. In addition to its antiseptic effect, it might, as

[1] Deut. med. Woch., 915 and 2266, also 1911, p. 2079, and 1912, p. 1450.

[2] Bull. et mém. de la soc. méd. des hôpitaux de Paris, 1913, No. 29, p. 573.

mentioned, perhaps assist the radiographist in bringing out more clearly the contours of the distended bronchi, the same as is done with the pelvis of the kidney in pyelography.



Ephraim's apparatus for endobronchial treatment by means of spray.
1, cannula for introduction (can be taken apart).

II. Operative Treatment. *General Remarks.* 1. *Preparation of the Patient:* It is advisable that the patient, for a few days before operation, retain, as much as possible, a posture which favors the emptying of the bronchiectatic cavities, *i. e.*, lies on his right side when the disease is in the left lung and *vice versa*. In addition, we keep the patients in a knee-elbow posture for an hour or two immediately preceding the operation, and make them cough out thoroughly, before placing them on the operating table. This reduces the danger of aspiration pneumonia.

2. *Anesthesia:* The danger of the occurrence of aspiration pneumonia makes general anesthesia inadvisable, except for short periods. Regionary and local anesthesia are preferable. Corresponding to the ribs to be resected and to the site of the intercostal incision, the respective thoracic nerves are previously infiltrated with ½ to 1 per cent. novocaine-adrenalin solution. Then the line of incision is prepared in the same manner. Ten to fifteen minutes at least should be allowed to pass, before proceeding to cut. Even in excited patients the work is now nicely feasible. But the narcotizer must be on hand; now and then a few whiffs of a general anesthetic may be required; sometimes a mock anesthetic of alcohol plus water in equal parts suffices. For the incision of the pleural cavity, however, a brief superficial general anesthesia is advocated, in order to avoid the reflex cough and straining on the part of the patient during expiration.

3. *Differential pressure apparatus:* The advantage of having various types of apparatus to select from becomes manifest in this instance again. The apparatus is adapted to the patient, and not the patient to the apparatus. It is the consensus of opinion, that in this kind of operation it is best for the patient to have the mouth free and unencumbered; the patient is constantly urged during the operation to expectorate and, of course, must be able to do so. That calls for the use of a positive pressure cabinet, or a negative chamber. Of the two the negative pressure is preferred, because it makes expectoration easier and lessens the danger of aspiration. At all events some kind of differential pressure apparatus should be ready for use, because there may be no adhesions whatever between pulmonary and costal pleura, in spite of many years of sickness. Personally, when operating on these cases, I have the differential pressure apparatus in readiness, and turn on the pressure when it appears that adhesions are missing.

Special Remarks. A. Pneumotomy: This operation is indicated in cases in which a circumscribed bronchiectatic disease of the lung could be diagnosed clinically.

As the first step, a wide resection of a number of ribs (two to three) that overlie the cavity, with their intercostal tissues is essential. Then the aspirating needle (medium size) is introduced, until pus is found.

Be it remembered, however, that it is best not to push the needle forward until after the costal pleura has been divided, to make sure that adhesions are present. In one of my cases I assumed such adhesions as a matter of course, in view of the long duration of the disease, but when using the cautery alongside the needle in order to open the abscess, the free pleural cavity was entered, and at this moment the syringe, which was held by the assistant, slipped off the needle which had no thread (Record) nor bayonette arrest. The patient coughed and some pus spurted out of the needle and dropped into the open pleural cavity. Drainage of the latter became necessary, complicating and retarding the patient's convalescence. If no infection of the cavity had occurred, immediate suture of the lung to the costal pleura would have been indicated. Be it further remembered, that *aspiration of air* into the barrel of a *well-working* and previously tested syringe, is just as significant and pathognomonic for the presence of cavity formation, as that of purulent material. As stated above, we insist upon our patient's emptying their bronchiectatic cavities as far as is possible before operation. We consequently must expect to have many of them filled with air rather than fluid material.

Alongside the needle, as a guide, the lung is freely incised with a knife, better with a cautery. Sometimes the sought for cavity is found in considerable depth, in some of Lenhartz's cases as deep as 20 to 26 cm. (8 to 10 inches) below the surface of the chest.

A free lung incision is indispensable in cases in which the cavities are not far from the surface, in order to be able to cope with a hemorrhage. Large bloodvessels may be encountered and we must be able to ligate them if injured. If the cavity is deep, knife and cautery must be laid aside and gentle and careful progress made with a blunt, straight dressing forceps, for,

the nearer the hilus of the lung, the larger are the branches of the pulmonary vessels. Aspiration of air with subsequent air embolism has been observed in case of injury to these blood-vessels. When the cavity has been struck, boring with the finger and other manipulations in the dark are to be avoided; drainage with rubber tube and additional tamponade with iodoform gauze follows. The wound must heal as in other abscess cavities. That a liberal excision of the chest wall greatly favors this has been mentioned before.

If, during operation, it is found that adhesions are absent, and the free pleural cavity is entered, the question may come up whether a two-stage operation is advisable. For many reasons the surgeon should try to finish the work in one sitting. With the patient under differential pressure he has time and tranquillity of mind to carefully palpate the lung. Not infrequently an infiltration will show the seat of the trouble in the depth. This area is stitched to the costal pleura, best with Roux's suture (a continuous mattress stitch which always re-enters at the last exit of the needle, just as some operators use it for the skin and glabella in brain surgery according to Heidenhain), and then opened as it was described above in the presence of adhesions. Only in very weak patients should the two-stage operation come into consideration, viz., resection of the chest wall, with the application of chloride of zinc or with gauze tamponade as the first step, followed one to two weeks later by lung incision.

It should be emphasized once more, that pneumotomy as the *first step* is indicated only, or at least principally, for the drainage of one larger bronchiectatic cavity. With sufficient mobilization of the chest wall, results may be very gratifying. In May, 1913, I was able to present a young lady, who had suffered from circumscribed bronchiectatic abscesses, treated in this way, before the New York Surgical Society (*Annals of Surg.*, 1913, p. 700). Here the right upper lobe had been the seat of the focus, which latter was the result of an aspiration pneumonia, following an abdominal operation.

If the disease is spread over a large area, prolonged drainage

to the surface of the thorax will reduce the quantity of expectoration as long as drainage is free; but with the contracting wound, the temporary improvement may be lost and a permanent bronchial fistula with insufficient drainage become established. In the three cases under my own observation, who died from acute meningitis, this latter complication set in when the drainage wound contracted. This may have been a mere coincidence; on the other hand, it may also have some significance.

In exceptional cases pneumotomy may be indicated in spite of a more diffuse affection, because prompt free drainage of the bronchial tree downward to an external wound appears imperative in order to reduce the intrabronchial putrefaction. Thus one of my patients, a young girl of twenty, with a diffuse affection of the left lower lobe since childhood, who for two years had been condemned to solitary confinement on account of the terribly foul odor of the expectoration, was a few weeks after operation so much improved that she could re-enter the ward.

Greater difficulties present themselves to operative therapy, if multiple larger and smaller bronchiectatic cavities are present in one or several lobes of the lung. It is evident that pneumotomy cannot fulfill the just indicated primary need.

B. The next possible step in our present status of operative interference is collapse-therapy. This, as stated above, can be accomplished (1) by the production of a therapeutic pneumothorax, by means of nitrogen insufflation, as used in pulmonary tuberculosis; (2) by pneumolysis with or without introduction of a plomb; (3) by thoracoplasty (multiple rib resection) with or without (4) phrenicotomy.

1. *Artificial Pneumothorax:* Artificial pneumothorax has entirely failed in cases in which the trouble was at all advanced. The former symptoms returned unmitigated when the insufflation was discontinued, even though it had been permanently practised for a number of years. (Volhard, one case, two years' treatment. Schmidt, on basis of 8 cases, also pronounced the method a bad one.) In view of the experience so far had with nitrogen insufflation, it cannot, therefore, be recommended as a

means of cure or even permanent improvement in somewhat advanced cases of bronchiectasis.

2. *Pneumolysis Plus Introduction of a Plomb:* The latter will permanently and equally compress the lung. Subperiosteal resection of a piece of rib, about 7 to 10 cm. (3 to 4 inches) long; careful splitting of the posterior layer of the periosteum with underlying intrathoracic fascia. Blunt division of the latter from the next layer, the costal pleura, which will gradually afford an entrance into the chest for three to four fingers of the operator's hand, and enable him to loosen the lung from the inner surface of the ribs, without opening the pleural cavity. The big cavity thus created is then filled with fat, extirpated from another part of the patient's body, or a lipoma, or omentum, kept in cold storage (Tuffier), or a paraffin plomb is introduced (Baer, Jessen, *Münch. med. Woch.*, July 22, 1913). It is evident that in this way the compression of the lung is accomplished in an effective, because permanent, way. The operation is not a serious one. In Tuffier's series of cases, 20 in number, recently published by Lenormant, there was no mortality. All cases were improved, but none cured (*Presse Méd.*, 1913, vol. xxi, p. 786).

3. *Thoracoplasty:* Another useful surgical intervention, though perhaps somewhat less effective, is multiple rib resection (*thoracoplasty*) with the help of raising a skin muscle flap or of Sauerbruch's hook-incision or Wilms' columnar resection. Quite a number of ribs are excised under regionary and local anesthesia, as above described. The wounds are sutured with rubber tube drainage. Primary union usually sets in. The effect sometimes is splendid. Graser recently reported what looked like cures in two cases operated upon in this manner. Sauerbruch repeatedly saw great improvement. I had one case cured (see above). But these results are exceptions. The majority of authors agree that, as a rule, improvement only can be expected of the method. This has also been my experience in two cases, one of total thoracoplasty done in three stages, after ligation of the branch of the pulmonary artery which feeds the right lower lobe;

the other after resection of the left sixth to tenth ribs following ligation of the pulmonary branch for the lower lobe of the left lung. The impossibility of a *cure* by these means in advanced cases can be readily understood, even with additional,

4. *Phrenicotomy:* Resection of a piece of the phrenic nerve at the neck, by which half of the diaphragm, on the diseased side, is artificially paralyzed.[1]

As has been said in the beginning, bronchiectasis is a disease of the bronchial tree, and not of the pulmonary parenchyma. Cavities of the bronchi, especially the larger ones, with their hard, often calcified walls, cannot be influenced by any amount of compression or collapse of the lung. The smaller cavities, however, will be greatly improved by the collapse of the alveolar tissue, and catarrh as well as retention of secretion will be much reduced. This, in turn, improves the discharge from the larger cavities, lessens decomposition of the formerly stagnant secretions and reduces absorption of toxins which had kept up the vicious circle of poisoning the system. The patient's general condition consequently improves.

In bilateral bronchiectatic affection, thoracoplasty is contraindicated, because expectoration may become greatly interfered with, if a number of ribs are removed on both sides of the thorax.

Recognizing the limitations, in advanced cases of multiple cavity formation, of pneumotomy and the collapse-therapy, surgeons evolved more radical operative means to be combined with thoracoplasty.

C. 1. Thus Garré, after liberal rib resection, mobilized the lower lobe of the lung by lifting it entirely out of the complementary space and transposed it upward, after it had retracted toward the hilus. The border of the lobe is stitched on to the convexity of the diaphragm and the complementary space allowed to close under tamponade. A marked improvement in the patient's condition was seen. In another case, treated by

[1] It has been seen after this operation, that the dome of the unilaterally paralyzed diaphragmatic muscle rises up to the second or third rib and thus compresses the lung from below *ad maximum*.

Garré the same way, an extensive secondary pneumotomy became necessary, and finally the entire lobe had to be extirpated.

2. Sauerbruch tried to produce carnification of the lung tissue by a different, very ingenious procedure, already referred to above. On basis of experimental work which he had done in conjunction with Bruns, he ligated the respective branch (or branches) of the pulmonary artery which carries blood to the lung *for aëration*. The abolishing of its physiological function brings about the atrophy and gradual carnification of the lung tissue. Far-reaching connective tissue proliferation occurs and the pulmonary pleura becomes adherent to the costal. If then, after some time, thoracoplasty and, in cases of disease of the lower lobe, cervical phrenicotomy are added, pronounced carnification plus compression has been accomplished. Sauerbruch has carried out the ligation of branches of the pulmonary artery on this indication seven times. I myself have done it three times and H. Morriston Davies of London once (*British Journal of Surgery*, 1913, vol. i, No. 2, p. 250). All the patients recovered from the operation. Respiration and heart action were never interfered with. The operation is not a serious one. All patients were improved; some very materially; none lost the expectoration entirely. At best the sputum was reduced to 20 to 50 c.c. (1 to 2 ounces) in twenty-four hours.[1]

INTRAPERICARDIAL LIGATION OF THE FIRST DIVISION OF THE PULMONARY ARTERY.

The ligation of the branch of the pulmonary artery feeding the diseased lobe is not always an easy operation technically.

[1] A new and effective way of producing profound collapse and atrophy of pulmonary tissue has been devised by Henschen of Zurich. At the last meeting of the International Surgical Congress in New York, April, 1914, he pointed out that, according to his experimental work, total atrophy of the affected lower lobe of the lung was produced by its subdiaphragmatic transposition in combination with, and rendered possible by, artificial paralysis of the diaphragm on the same side, by means of phrenicotomy. Further experimental experience followed by practical tests of the method in man will have to decide its usefulness.

On account of dense adhesions it may prove difficult to enter the interlobar space where the artery must be found and tied. Injury of the lung tissue and smaller bronchi with exit of infectious material may thereby occur. There are many anatomical variations.

In view of these facts, the writer proposed last year, on basis of experimental studies, particularly in affections of the right middle and lower lobes, to reach and tie the right pulmonary artery, viz., the first division of the main trunk within the pericardium.[1] In the dog this operation is fairly easy, and in all probability will not be very difficult in man, at least as far as the left pulmonary artery is concerned. In order to reach the right main trunk in man, a trap-door incision of the sternum appears necessary—a somewhat complicated preliminary operation. The right pulmonary artery is best ligated within the pericardium between the descending vena cava and ascending aorta. If these two vessels are held apart, the artery is met with in the depth of its transverse course, posteriorly to the two vessels named. However, this very place is covered by the body of the sternum. It is possible, and seems plausible, that this work might be facilitated and access to this spot more conveniently gained with the help of longitudinal splitting of the sternum.

The cause of the failure of all these methods to effect a real cure, has been repeatedly dwelt upon above. If they are to be truly effective, they must be carried out before the walls of the larger bronchiectatic cavities have become rigid. In other words, they must be done in the earlier stages of the disease. Be it therefore repeated and emphasized once more: The combined efforts of all interested will have to be directed toward proving by favorable operative statistics, that an established case of bronchiectasis is a surgical disease, which had a chance of a cure by milder operative methods only, if without delay an aggressive therapy had been employed against the first

[1] The Surgery of the Pulmonary Artery, Annals of Surgery, August, 1913.

manifestations of the disease. Meanwhile we have to deal with the facts as they are. All the patients with bronchiectasis reaching the surgeon today are advanced cases. Our operations have so far only improved their desperate condition. If we want to be certain to effect a cure, there is only one procedure that can be considered, namely:

EXTIRPATION OF THE DISEASED LOBE (PNEUMECTOMY)

The operation is one of magnitude, principally on account of, first, the vagus reflexes in handling the bronchus near the hilus; second, the possible strong adhesions in this region when the disease has been of long-standing; third, the tendency of the bronchial stump to slip back when no adhesions are present, and fourth, the deadly "pressure-pneumothorax," if the pleural cavity was thoroughly closed after the extirpation, but the occluded bronchial stump leaks. A further problem is presented by the difficulty of closing the bronchus air-tight, if the separation of the large bloodvessels accompanying it and their isolated ligation cannot be carried out. If isolation and ligation of the vessels is feasible, as it will be in favorable cases with the bronchiectatic affection confined to just one lobe and missing pleural adhesions, I firmly believe that the method which has given me such uniformly satisfactory results in dogs, viz., crushing of the bronchial cartilages with a strong clamp—Doyen's intestinal crusher—with inversion of the tied stump and a number of top sutures (*Centralbl. f. Chirurgie*, 1909, No. 50), will prove to be a safe procedure in making the bronchus air-tight also in man. Wedge-shaped excision of the lung tissue towards the bronchus after the tying of the main vessels, division of the bronchus before it is crushed, and treatment of its mucosa by means of scraping with the curette and disinfection with pure carbolic and alcohol, or with the Paquelin cautery, and stitching the small amount of retained lung tissue over the ligated and inverted stump, will be important additional factors in making for success.

So far 16 cases of pneumectomy for bronchiectasis have been reported.

Seven of these were done in the presence of far-reaching adhesions, with six recoveries and one death.

Three were done without the presence of adhesions between pulmonary and costal pleuræ, with one recovery and two deaths.

In six cases no statement is made regarding pleural adhesions. Of these one recovered (improved), and five died.

Total: 16 cases, 8 cured or improved, 8 died.

Let us hope that the statistics will soon improve by persistent work along these lines and that we shall learn how to overcome the technical difficulties and dangers to the patient in this clearly indicated and proper radical procedure.

Summing up I would say:

If a patient comes to the surgeon today with a well-developed diffuse bronchiectasis and asks for relief, he should be told that at the present moment we have two operative methods of treatment at our disposal. The one, entailing comparatively little risk, and to be done in stages, will change the anatomical structure of the lung and make it collapse, but in all probability will only improve the trouble to a greater or less extent; while the other one, consisting in extirpation of the diseased lobe or lobes of the lung, if successful, may cure, but is still a dangerous procedure. The patient or his guardian must decide which course should be followed. It is to be expected that the majority will select the first procedure. Pneumectomy, then, always remains as a last resort, should the less serious operations fail to bring sufficient relief.

DISCUSSION

Dr. Gerardo M. Balboni, Boston (by invitation).

I appreciate the privilege of being allowed to take part in the discussion before this Society of a subject in which I have been much interested.

My experience with artificial pneumothorax is based upon sixty-one cases treated during the last three years. Fifty-seven have been cases of pulmonary tuberculosis, four cases have been non-tuberculous. The experience with these four cases is pertinent to this discussion. There were two lung abscesses and two cases of bronchiectasis.

Case LIII.—A man, aged fifty years, with an extensive abscess involving practically the whole left lower lobe. General condition poor; great emaciation. Only a small portion of the upper lobe was free from adhesion. Treatment was attempted in this case because the condition of the patient did not permit of operation. Only a partial pneumothorax was possible. Treatment had to be suspended as increasing pressure caused cardiac distress. In this case the sputum was markedly reduced in amount and the distressing cough was relieved; he was able to lie flat and sleep, where previously he was unable to do so.

Case LIX.—A man, aged thirty-seven years, with diffuse bronchiectasis of the right lung and to a lesser extent of the left lower lobe. It has been possible to secure only partial collapse of the lung up to the present time on account of extensive adhesions. Nevertheless the amount of sputum has been reduced to one-fourth and considerable relief in the symptoms has been obtained.

Case XXI.—A laborer, aged thirty-seven years, with a lung abscess located between the second and third rib on the right side. It was possible to sufficiently collapse the affected lung and maintain it compressed for five months, when in the absence of symptoms and a general state of well-being, treatment was suspended, and the lung was allowed to gradually reëxpand. It is nine months since full re-expansion has occurred and the patient is free from symptoms and in good health.

Case XXII.—A man, aged forty years, with a diffuse bronchiectasis more marked in the lower lobe of the left lung. It was possible to completely collapse this lung and it was so maintained for one year. In the absence of symptoms and a general state of well-being, reëxpansion was permitted to gradually take place. It is now eight months since complete reëxpansion, and the patient is

FIG. 1.—Case LIX. Diffuse bronchiectasis of both lungs. More extensive on the right.

FIG. 2.—Case LIX. Diffuse bronchiectasis, extensive on the right. Partial collapse. Upper lobe collapsed. Middle and lower lobes where the process is only partially collapsed.

free from symptoms and in good health. I can speak of these two latter cases as cured.

The puncture method has been used in all these cases.

The chief dangers associated with this method of treatment are pleural shock, gas embolism, spontaneous pneumothorax from rupture of the lung, and rupture of the mediastinum. Pleural effusion, which so often complicates nitrogen treatment in cases of phthisis, has never been noted, so far as I am aware, in these non-tuberculous cases. Spontaneous pneumothorax from rupture of an adhesion or puncture of a cavity is possible from too high a pressure. Puncture of the lung

FIG. 3.—Case XXII. Bronchiectasis of left lung. July 17, 1912.

and rupture of mediastinum may be avoided by careful technique. I believe that pleural shock is rare and gas embolism ought to be avoided. Pain and severe cough occasioned by the injection can be controlled.

THE TECHNIQUE. The puncture method has been used in all these cases. It is best to produce the pneumothorax gradually by frequent injections of nitrogen and bring it up to the desired volume and pressure. The rapid production of a pneumothorax by large quantities of nitrogen is dangerous as it does not give the adjacent organs time to adjust themselves to the changed conditions; besides,

the expulsion or sudden evacuation of large quantities of purulent material through the trachea may drain back and infect sound lungs.

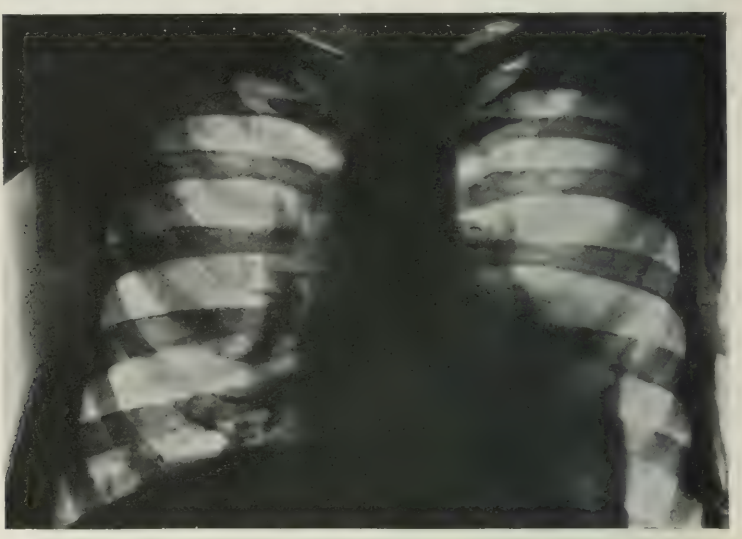


FIG. 4.—Case XXII. After injection of 1200 c.c. nitrogen, showing partial lung collapse. July 25, 1912.

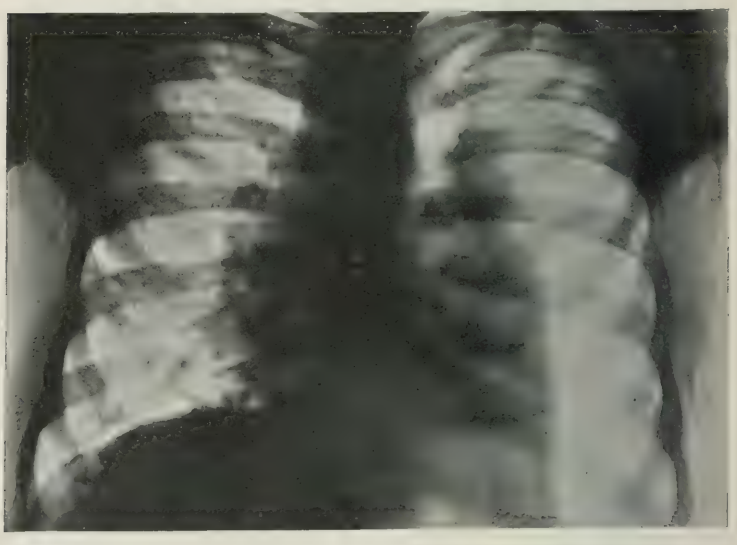


FIG. 5.—Case XXII. After more nitrogen was injected. July 31, 1912.

To obtain the desired result from artificial penumothorax it should be maintained uninterruptedly for the whole period of treatment so as to bring about anatomical healing.

The Manometer. It is worth repeating here that the manometer may show respiratory oscillations of three kinds: (1) negative: (2) even oscillations (by which is understood that the excursions on the manometer are equal on inspiration and on expiration, and (3) positive.

Fig. 6.—Case XXII. Lung reëxpanding. Patient free from symptoms. July 17, 1913.

1. Negative respiratory oscillations always mean that the point of the needle is in the pleural cavity.

2. Even respiratory oscillations at a first introduction mean that the point of the needle is beyond the pleural cavity, *i. e.*, in the lung. No matter how much nitrogen is introduced under these conditions, the oscillations will not vary.

Even respiratory oscillations at a subsequent introduction may mean that the point of the needle is in a pocket of gas or a partial pneumo- or hydropneumothorax, or in the lung. If not in lung, on the introduction of nitrogen the pressure will soon become positive. (Physical signs and *x*-ray plate will make the condition clear).

3. Positive respiratory oscillation indicates that the point of the needle is either in a pocket of gas, a complete pneumothorax, or a

hydropneumothorax and under these conditions the pressure becomes higher on the introduction of a very small amount of nitrogen.

4. At a secondary injection when a pleural effusion has formed, the point of the needle may be in the pleural cavity and the manometer may show only slight or feeble respiratory oscillations slightly negative or markedly negative in character. Or there may be simply a negative rise on inspiration, with no oscillations whatever. Under these conditions, when the needle is removed a drop of fluid may be observed on the end of the needle, especially if the stylet is passed through its lumen.

FIG. 7.—Case XXII. Lung fully reëxpanded eight months after suspending treatment. No symptoms. January 28, 1914.

If the point of the needle is in a bloodvessel only a rising positive pressure will be noted.

A febrile reaction, lasting a short time, usually follows each injection. There is usually loss of weight during the treatment. The gain in weight on reëxpansion of the lung when treatment is suspended is very marked. It is very important not to allow the lung to expand prematurely. Once the lung has reëxpanded after nitrogen compression the pleural surfaces coming into contact adhere, preventing a further collapse of the lung. The time to keep the lung collapsed varies with each individual case, depending on the extent and char-

acter of the lesions. It is better to err on the side of keeping the lung collapsed a longer rather than a shorter time, for cicatricial healing takes place slowly. It is necessary to keep the lung collapsed at least a year. When a patient has been free from symptoms four or five months we may allow gradual reëxpansion to take place. If, while the lung is reëxpanding there should be a return of symptoms, treatment should be immediately resumed.

The physician must have complete control of the patient.

Frequent *x*-ray examinations are an essential part of the treatment.

Artificial pneumothorax is not an indifferent procedure and should be undertaken only after careful consideration of each individual case. The patient should have full knowledge that the treatment is long, tedious, troublesome, and expensive, and not devoid of dangers.

I thank you for the opportunity of presenting this communication.

Dr. John B. Murphy, Chicago.

I have been extremely interested in all the papers on the lung, as well as those which preceded them, on the bloodvessels. I will not go into detail regarding the papers on the bloodvessels and mediastinal work, with the exception of mentioning that you will note in this morning's discussion the particular absence of the element of minus or plus pressure, as a necessity in these operations. I also wish to call attention to the fact that the tendency is to return to the technique that I advocated in 1896 and 1898. Again, to call your attention to the fact that there is no great danger from pneumothorax, if one recognizes the conditions which tend to produce a mortality. If one immobilizes the mediastinum and fixes the lung hilum there is no danger. What danger is there from collapse of the lung? Practically none, based on my personal experience and observation in from 2300 to 2400 lung compressions. What are the conditions that have led to the work that has been presented this morning that is such a monument to surgery? What is the tendency of it all? What is the simplest method of placing the lung at rest? Pneumothorax. Why is that not more frequently adopted in America? When I read my original paper in 1898 it was taken up by that master of internal medicine, Prof. Brauer, then of Breslau, now of Hamburg, and he has exploited it in Europe, and now it is coming back to America. The principles which govern its administration are exactly the same as those we have carried out till this time, and in 2400 compressions, with one accident only, and that a pulmonary embolus due to the insertion of a needle into the adherent lung, the results have been

exceptionally good. That the lung can be easily and effectively collapsed without danger is an absolute certainty. The conditions favorable to the suspension of progress of tuberculosis are the conditions which favor cicatrical contractions, because tuberculosis always repairs by cicatrization. That this method will not cure bronchiectasis, with or without adhesions, seems evident from the character of the wall of the cavity which differs from the wall of the tuberculous abscess. If we will run through this series of cases presented today we have the magnificent operations showing that the chest can be opened, explored, and that all that work can be done without special danger from pneumothorax if one immobilizes the mediastinum. In my earlier work when I let the mediastinum vibrate on inspiration the septum moved to the side that was healed; on expiration, to the other side; there was, therefore, no respiratory exchange produced. In the human, if you will open the chest wall and compress the mediastinum to the opposite side you can go on with the work on the open side without serious inconvenience to the patient.

I recall in one case in which I opened both thoracic cavities where I was removing the anterior wall of the chest for carcinoma, that in taking off the left side of the sternum I opened the right pleura. I heard the intake whistle and compressed the opening in the mediastinum with my finger, completed the operation, sutured the mediastinum, replaced the chest wall flap, aspirated the air out of the side on which I had operated, so as to reëxpand the lung. The patient went on to an uneventful recovery.

I feel that we are not excused as a profession for postponing the institution of pneumothorax as a treatment for tuberculosis until we have the superlative lesions demonstrated today and for which the more serious operations are done. We see all of the tuberculous cases early and pneumothorax can and should be instituted as a treatment in the initial stage. It is as irrational in my opinion to wait for the development of the superlative lesions from tuberculosis of the lung before instituting pneumothorax, as it would be to wait for a general suppurative appendicitis to develop before instituting treatment for appendicitis. Pulmonary surgery of tuberculous lesions must be a prophylactic surgery, just the same as the abdominal surgery of peritonitis is now a prophylactic one.

Dr. E. Wyllys Andrews, Chicago.

I will follow my colleague, Dr. Murphy, to emphasize a point which has not been sufficiently brought out, the want of any indica-

tion for any kind of lung inflation in unilateral chest operations. Experimental surgery has shown us that opening one pleural cavity is without risk and we can go further and say that the opening of one pleural cavity does not in all cases stop the function even of the lung on that side; resection of the chest wall does not necessarily collapse the lung.

In a recent case in which a severe crushing injury had torn the cartilages from the ribs on one side, about four of them, separating the ribs from the sternum, not only had the lung expanded fully with respiration, but projected itself outside the laceration by some kind of active inflative power. It is contrary to the rules of what we now know of mechanics, that the lung should have a positive expansive power, but it is true. If you had seen a lung as I have, a lung expanding with each respiration enough to thrust itself out into the outer air, you would believe that not in all cases will the lung collapse. Of course everybody recognizes that it is perfectly harmless to get a gradual collapse of the lung. A patient at rest can carry on all functions of respiration with one side. It is not so easy to believe that a lung can function after a sudden invasion of the chest wall. It is, however, what I believe Dr. Murphy meant to say, and I will say it, that one can cut a wide opening in the chest with comparative safety. In the majority of instances even should the lung collapse, no great harm is done, no shock or collapse is seen with one side intact.

Dr. Frank E. Bunts, Cleveland.

I wish to agree with Dr. Andrews in regard to the innocence of opening one side of the chest and performing almost any operation necessary without any artificial means of insufflating the lung. My experience has not been very great and is confined to two lung abscesses and three small intralobar abscesses which could only be located by the *x*-rays. The difficulty, I found, was that with the stereoscopic radiograph we could accurately locate the abscess and then by means of this insert the needle and corroborate the radiographic findings by withdrawing pus, but on removing a couple of ribs the lung collapsed to such an extent that we could not then find the abscess, and it was only by reaching up and catching the lung and squeezing it that I could squeeze out the pus and find the site of abscess. Then it was easy to put a pair of dressing forceps into the abscess. One would think that after such an operation on inserting the tube in this space the tube would be going up and down at a bad angle for drainage and that in consequence we would get a large

empyema. I presume the reason we did not get an extensive empyema was because the lung expanded and because adherent to the chest wall; there was a small discharge of pus and the patient, aged twelve years, made a satisfactory recovery. In those cases in which the lung is adherent to the thoracic pleura ordinarily it is an easy matter to find your abscess, but if not, I have found that in removing the ribs there was nothing to show exactly where the abscess was, and you can make punctures with your needle in various directions and yet not find it. But if you puncture, with your radiographic findings as a guide, then you can locate your abscess and leave the long needle in while making the resection and then follow with the dressing forceps, open the cavity, and secure good drainage.

Dr. Emmet Rixford, San Francisco.

It would seem that sufficient emphasis had not been given the physiological differences between unilateral, closed, and open pneumothorax, and I would like to reiterate the statements made in my paper read before this Association at its meeting in 1905, viz., that in closed pneumothorax the pressure of the contained air is exerted uniformly on the mediastinum, which is a sort of vertical diaphragm between the two pleural cavities, and virtually fixes it, permitting alternate expansion and compression of the lung on the sound side, and that, on the contrary, in open pneumothorax the mediastinum flops from side to side to such an extent as seriously to interfere with respiration. Its movements lessen the vacuum on the sound side of the chest in inspiration and lessen the compression in expiration.

A considerable degree of compensation, however, is produced by the automatic increase of the rate and range of respiratory movement as well as the pulse rate. Under such compensation considerable operative work can be done on the chest wall and the intrathoracic organs before fatigue of the overacting muscles reaches the danger point. When cyanosis comes on or the respiratory efforts become too labored, rest can be obtained by converting the open pneumothorax into a closed pneumothorax by simply closing the opening in the chest wall with any convenient covering. I have used for this purpose with much satisfaction a folded towel which is made less pervious to air by being wet with water or salt solution, preferably hot; the operative manipulation being renewed when the pulse and respiration have recovered. Or, again, depending on the nature of the operative procedure one can compromise and after opening the chest make some resistance to the ingress and egress of air by having an assistant keep the opening partially closed with his hand or with

a wet towel. In this way extensive resections of the chest wall, removal of mediastinal glands, resection of lung, etc., may be performed with comparatively little danger and under ordinary ether anesthesia. In this way I have personally performed ten consecutive extensive resections of the chest wall for tumors, in one including resection of a portion of the lung, in others, removal of mediastinal glands, without mishap and without resorting to any form of differential pressure apparatus.

In a number of instances I have endeavored to prevent the lateral excursions of the mediastinum by making direct pressure upon it with the gloved hand, as has just been suggested by Dr. Murphy, but while the manœuvre has worked with some degree of satisfaction on the right side, on the left the great degree of pressure required was resented by the heart. The advice of Delageniere to produce the pneumothorax in the first instance gradually is important to be followed.

While I do not wish to be misunderstood as disparaging in any way the Meltzer-Auer positive pressure technique which I am glad to say has afforded a long-sought-for solution of the respiratory part of the problem of intrathoracic surgery, I feel that some older methods should not be forgotten, and I would again call attention to the fact that with the wet towel, which is always at hand, can safely be performed a large majority of the justifiable intrathoracic surgical operations.

Dr. Fred T. Murphy, St. Louis.

The important point I wished to make was to impress the fact that it was essential to differentiate between the conditions where the thoracic cavity was to be opened and where it was not to be opened. In the acute abscesses it seemed to me and still does, although Dr. Bunts has had a large experience, that it is essential to fix the chest wall before drainage. As regards the use of the negative and positive pressure and intratracheal insufflation, that is hardly my responsibility, still I feel it is essential to fix the chest wall and not to use a general anesthetic and I believe that it is distinctly essential to use intratracheal insufflation in the cases where the exploration is extensive and the chest wall widely opened. A comparison of the methods will convince anyone. In this discussion the remarks have been qualified by the statement that in nearly all cases nothing happens when the lung collapses. Why take the chance in the odd case with such a simple method as that of Meltzer and Auer at one's disposal?

Dr. Howard Lilienthal, New York (in closing).

To correct what seems to be a misapprehension on the part of Dr. Andrews, I would point out that when he has seen the lung extrude itself from the chest that the motion was not one of respiration, but rather one of inflation, the patient probably groaning or straining with closed glottis and the air being forced into the lung from its fellow.

As to the matter of tamponade, I may state that I have tried paraffin and also fat, and would strongly urge the use of the latter, which is not a rigid body but a soft and plastic one easily adapting itself to the cavity, in which it is placed. Successful transplantation of fat is easy, as shown by the experience of the ophthalmologists who transplant into the orbit. I had occasion to observe the transplanted fat at a secondary operation in one of my cases and it looked perfectly normal and well nourished in spite of the presence of some infection in the neighborhood.

Dr. Samuel Robinson, Clifton Springs, N. Y. (by invitation, in closing).

I wish to make a point in connection with the treatment of bronchiectasis. Compression of the lung is important. Artificial pneumothorax will compress the lung in the early cases, and if the cases come early, artificial pneumothorax will at least be a sufficient treatment to produce compression. Unfortunately the cases do not all come early. The compression should then be done by rib resection, if necessary, conservatively performed. This is another point: all of the cases, with one exception, of complete removal of the lobe of the lung for an infectious disease like bronchiectasis have been the result of a series of operations previously performed, not meaning to do a resection. Eventually the lobe of the lung was successfully excised. Every case of successful lobe excision has been accomplished by the two-stage method. Our approach to bronchiectasis should be with the idea of eventually excising it. No form of collapse therapy alone will succeed. First, artificial pneumothorax, rib resection next, if necessary; then produce lung compression and prepare for a subsequent excision. The fact that excision has failed in the one-stage operations almost universally should lead us not to attempt this in people with low resistance. Such an operation is attended with disaster which we cannot explain. Postoperative pneumothorax is a danger rather than the operative pneumothorax, and the function of the opposite lung is markedly restricted. Let us effectually seek to excise the pathological condition from bronchiectasis, but we should do it in stages.

With regard to abscess of the lung the mortality is low. I agree with Dr. Fred Murphy as to the necessity of local anesthesia when possible, and I think that we forget too, how often with a large flap lifted, and resection of ribs with ligature of intercostal vessels, that a space is left where anyone can see where the pleura is dull and where it is not. Opaque where adherent, transparent where it is not. By opening through the non-adherent part the abscess may be drained with success.

Dr. Willy Meyer, New York (in closing).

Let us bear in mind that bronchiectasis is a surgical disease and not a medical one. As soon as the internist's diagnosis is made he should turn the patient over to the surgeon, the earlier the better for a successful issue. Regarding the diagnosis: if the patient shows all the clinical and general signs of tuberculosis and again and again tubercle bacilli are not found in either the sputum or by inoculation experiments, he most likely suffers from bronchiectasis. Let us hope that with the insufflation of collargol solution into the bronchi an improvement may be made in the stereoscopic radiography of this condition.

The necessity of early operation has been mentioned. Collapse and compression of the lung is at present the principal method of conservative treatment. Regarding nitrous oxide insufflation, we heard today an excellent paper from Boston, in which it was stated that two patients with bronchiectasis seemed to have been cured by insufflation of nitrous oxide extending over a year. On the other hand Volhard has published one case where he most carefully and faithfully insufflated for two years with nitrous oxide, and when he stopped and the nitrous oxide had disappeared from the pleural cavity the disease recurred with the former intensity. Schmidt had similar experiences.

Dr. Henschen's excellent experiments are most inspiring. It stands to reason that we cannot always have fat tissue on hand which Tuffier likes to use. The paraffin plomb will often take its place.

If two lobes are affected, the middle and lower lobes of the right lung, the combination of collapse, ligation of branches of the pulmonary artery, and subsequent thoracoplasty makes the operation more difficult. We last year made experiments in trying to tie the principal division of the pulmonary artery intrapericardially and thus be absolutely sure of cutting off the blood-supply. We succeeded in doing this in dogs very nicely. The difficulty is that we need for

this a large flap operation including the sternum to reach the pulmonary artery in man. Perhaps Rehn's longitudinal division of the sternum will give better approach.

Regarding pneumectomy, we have found that out of 21 dogs we saved 17, when extirpating one entire lung with the crushing of the bronchial stump and inversion. The future must show whether this will be as useful a method in the human being.

In closing I would emphasize that I consider the use of differential pressure absolutely essential for safe work within the thorax. Its adoption represents the real progress made in this chapter of operative surgery within the last ten years. I am convinced that if we take 100 patients in whom we make an incision into the pleural cavity without differential pressure, and 100 patients with differential pressure, that there will be a much greater mortality in those operated on without differential pressure. The point is that differential pressure as such is taking thoracotomy out of emergency work. There is usually a severe collapse if we suddenly incise the free pleural cavity due to the acute pneumothorax and we do not know how far the patient will stand this sudden shock. Differential pressure has paved the way to opening the pleural cavity in a safe manner and the result is that with the same the pleural cavity is now as widely open to operative surgery as is the abdominal cavity.

THE PULMONARY AND PLEURAL COMPLICATIONS IN TROPICAL ABSCESSES OF THE LIVER

By JAMES E. THOMPSON
GALVESTON, TEXAS

A DESCRIPTION of the anatomic relations of the liver to the diaphragm and to the structures in contact with the upper surface of the diaphragm will make the study of the paths of direct extension of infection much easier to understand.

Most of the upper or convex surface of the liver is in contact with the diaphragm. Over the greater part of this area of contact the peritoneal cavity intervenes, potentially at least, each opposing structure being covered by its own layer of peritoneum. Over the rest of the area the liver and diaphragm are in actual structural contact, being separated by a layer of connective tissue only. *The area uncovered by peritoneum* is bounded in front by the attachments of the anterior layer of the right and left coronary ligaments and by their junction with falciform ligament; behind by the posterior layer of the right and left coronary ligaments, and their reflection on to the posterior borders of the lobes of the liver and the anterior surface of the vena cava. Fig. 1 representing the upper surface of a liver shows this area darkly shaded. The vena cava inferior grooves the liver at the middle of its posterior edge. It will be seen that at least four-fifths of this area lies in the right lobe of the liver. If a number of livers are examined in the dissecting room, it will be found in most cases that the highest point of the convex surface of the right lobe occupies a portion of the organ in front of this area, but that occasionally a liver is met where the uncovered area represents the highest point and occupies the dome of the diaphragm. A study of the under surface of the diaphragm shows a replica of the upper surface of the liver.

It has been stated by some writers that most liver abscesses that penetrate the diaphragm pierce it through this uncovered area. There is no doubt that it is a fairly frequent path of direct infection, but I have failed to find enough evidence to support the statement. It seems to be an easy matter for an abscess in any part of the liver to contract adhesions to the under surface of the diaphragm and to pass upward through it. The frequency

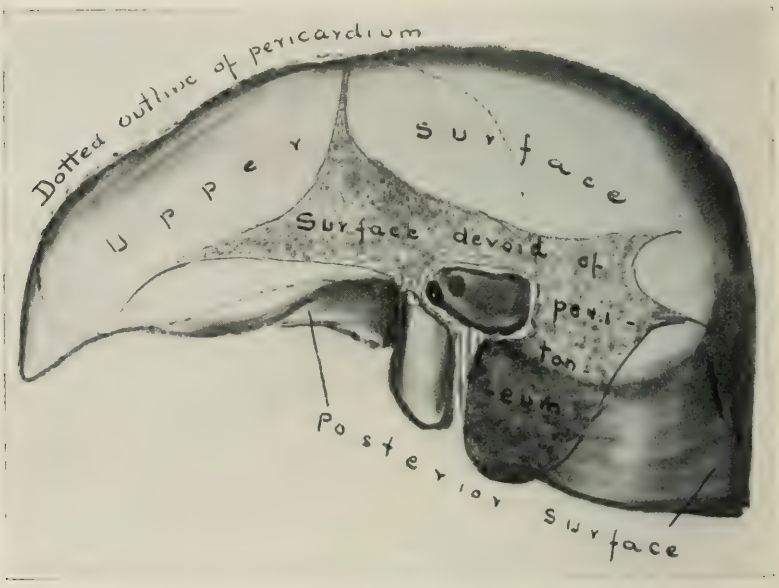


FIG. 1.—Upper and posterior surfaces of liver. Shaded area uncovered by peritoneum. Dotted line outline of pericardium. Most of this pericardial area is occupied by central tendon.

with which abscesses tend to point through the lower intercostal spaces in the axillary line, suggests at least that the peritoneum is no barrier. If an abscess occupies the upper portion of the right lobe of the liver, as it increases in size it will bulge toward the pleural cavity and the first effect will be to push the diaphragm against the chest wall, and obliterate the lower portion of the phrenicocostal sinus (Fig. 2). By doing so the lower edge of the lung is pushed upward, and is prevented from reaching the lower

limit of this space even in forced inspiration. If the abscess extends in this direction, adhesion of the two layers of peritoneum and pleura occur in advance, and both peritoneal and pleural cavities are obliterated at these points. If, however, the abscess extends upward it may open into the pleural cavity above these adhesions, or directly into the lung if adhesions have formed between it and the upper surface of the diaphragm. The structures lying on the upper surface of the diaphragm, that correspond

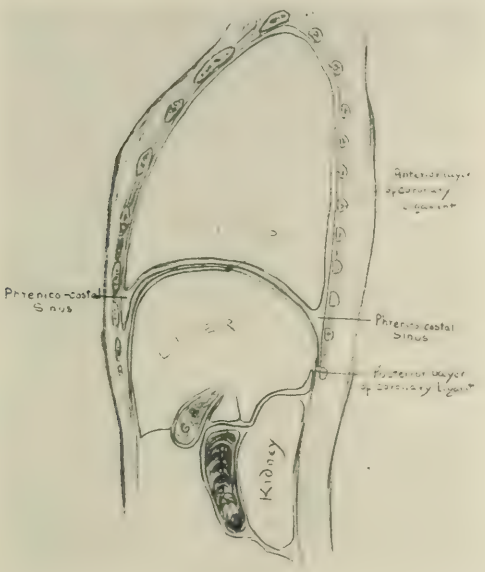


FIG. 2.—Right lateral sagittal section, three inches from medial plane.

to the upper surface of the liver, are the whole base of the right lung, the base of the pericardium, and part of the base of the left lung. Fig. 1 explains this clearly. The area in dotted outline represents the area of liver which is in relationship with the pericardium above. It is seen to occupy almost the whole of the upper surface of the left lobe and a considerable part of that of the right lobe, including almost half of the area uncovered by peritoneum. A very small area of the upper surface of the left lobe touches that part of the diaphragm in contact with the

left lung. The right lobe of the liver touches the diaphragm over the whole area corresponding to the under surface of the right lung. Fig. 2 is a right lateral, sagittal section, and shows the reflection of peritoneum in front and behind, from the upper surface of the liver on to the diaphragm and posterior body wall. The phrenicocostal sinus is shown in front.

Secondary extension of the inflammation from the liver to the lungs may occur in one of two ways.

1. By direct extension through the diaphragm.

2. By embolism of the pulmonary arteries due to the abscess bursting into the hepatic veins or into the vena cava.

From the preceding anatomical description the paths of direct extension into the pleural cavity and to the lungs will be easily understood. The pleural cavity is probably never invaded by metastasis but always by direct extension, and the same path usually holds good for the lower lobes of the lungs. The process with a few modifications is as follows: Extension of the original liver abscess proceeds toward the diaphragmatic surface of the liver. The diaphragm is incorporated into the abscess cavity and is gradually destroyed. What occurs next will depend on a number of factors. If the necrotic process is rapid and no antecedent pleurisy has caused adhesion of the lower lobe of the lung to the diaphragm or to the chest wall, the pleural cavity will be opened and the contents of the abscess emptied into it suddenly, producing serious fulminating symptoms of dyspnea and all the signs of an acute pleural effusion (Thompson). Usually the diaphragm is penetrated slowly and actual perforation is preceded by pleurisy, just as peritonitis precedes perforation of the abdominal viscera. The inflammation of the pleura may terminate in an accumulation of fluid, or in adhesions between the lung and the diaphragm or chest wall, or in both conditions to a different degree. In quite a large number of cases effusion is present in greater or lesser quantity. At first it is serous and sterile; later, it may become infected and seropurulent or purulent. At first the accumulation occupies the lower region of the chest cavity, the diaphragm forming its lower

boundary. If no adhesions form between the lung and the chest wall the whole pleural cavity may become involved and filled with fluid. Owing to the frequency of adhesions between lung and parietal pleura, localized collections in the lower portion of the pleural cavity or even between the lung and diaphragm are more common.

When the diaphragm is perforated finally, the pus from the liver mixes with the pleural fluid, imparting to it its own peculiar physical characteristics. The mingling of the two fluids is rarely attended by acute symptoms, because the pleural surfaces are now less susceptible to injury and the absorption of morbid products is less active. At the most, there may be slight increase in pain or dyspnea. The change of the fluid from serous to purulent may be discovered by chance even, at a subsequent tapping. When adhesions form between the diaphragm and the under surface of the lower lobe of the lung, the pleural cavity is shut off at an early date. As a rule, the application of the two surfaces is close and no cavity is left. But occasionally a small portion of the pleural cavity is imprisoned between the lower surface of the lung and the upper surface of the diaphragm. In the former case the inflammatory process passes slowly through the diaphragm into the lungs and the abscess cavity bores its way through the lung tissue until a bronchus is opened, into which the contents are finally discharged. In the latter the abscess opens first into the intervening cavity and later bores its way through the lungs.

The post mortem appearances of such conditions show marked anatomic variations. In some instances (usually recent cases) the hepatic abscess may still be of a reasonable size and the pulmonary track short and comparatively narrow. At a later date the track through the lung may be transformed into a large cavity which communicates with a similar cavity in the liver (Fig. 4). (Strong.) In others (older cases) the hepatic abscess may be reduced to a very small size, while the track in the lung may show extensive cavitation, of irregular shape and with ragged disintegrated walls. This disproportion between the cavities

in the lung and liver is often so marked that the liver abscess may be considered as practically healed (Fig. 3). The cause of death in such cases must not be ascribed to the destruction of liver tissue, but to the pleural or pulmonary complications; or, in rare instances, to metastatic infection of other organs. In one of our cases (Case X) an abscess had opened primarily into the lower part of the pleural cavity, the lung being penetrated secon-

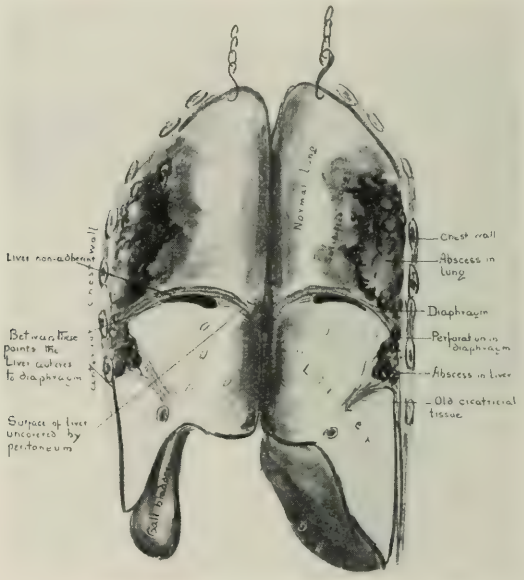


FIG. 3.—Specimen of liver and lung laid open, showing abscess in liver almost healed but abscess in lung is very large and active. (Path. Museum University of Texas.)

darily. The post mortem examination showed that the liver abscess had almost healed up and that nearly all the pus which was being discharged through the bronchi had been formed in the pleural cavity and in a cavity found in the lungs. The lower lobe of the right lung was occupied by a cavity as large as a man's fist, the walls of which were disintegrated and friable. The contents consisted of pus of a chocolate color. The cavity drained externally into a large bronchus and opened by a small

aperture into the pleural cavity. There was no direct connection between it and the liver. Careful examination of the upper surface of the diaphragm revealed a shallow excavation in its upper surface not more than one-half an inch deep and three-fourths of an inch wide. The walls of this cavity were formed by cicatrized liver tissue. Section of the neighboring liver showed an insignificant amount of cicatricial tissue. A profuse amount of

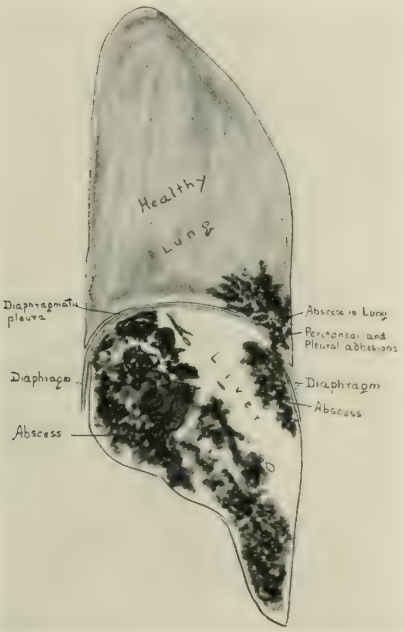


FIG. 4.—Sagittal section of lung and liver, showing multiple abscesses in the liver and a small abscess in the lung communicating with one in the liver. (Path. Museum University of Texas.)

pus typical of liver disintegration had been discharged daily for months in the expectoration and by drainage from the thoracic cavity. Death finally resulted not from liver or lung infection, but from infection (abscess) of the brain. In another case (Case XI) recently observed, giving a typical history of hepatic abscess with pleural and pulmonary involvement associated with expectoration of large quantities of chocolate pus, the lower

portion of the pleural cavity and the upper surface of the diaphragm were fully exposed to view by an extensive excision of the chest wall. No trace could be found of a liver abscess, although a most minute search was made. The pleural cavity contained a large quantity of thick, white pus mixed with masses of chocolate colored pus. We were also unable to find the opening from the pleural cavity into the lung. As this case recovered it is within the bounds of possibility that our observations may be incorrect. A similar case is quoted by Marion.

We have strong evidence pointing to transference of the amebic infection from the liver to the lungs, for Lafleur and others have shown that the walls of the pulmonary cavities contain amebæ, and they ascribe the extensive destruction of the lung to the agency of these organisms. It is impossible to explain the persistence of the symptoms and the extension of the ulceration by any other hypothesis. I have been able to collect some cases that seem to me to admit of no other interpretation. Such are the cases reported by Roch, Suzuki, Cantlie, Godlee and others, in which the presence of a liver abscess was clearly demonstrated as the primary infection either at autopsy or during life. In each one of these cases the liver abscess had healed up and the cause of death was abscess of the lung. Marion and Natton-Larrier have reported cases of amebic abscesses of the lungs in which the symptoms pointed strongly to hepatic abscess as a primary condition, but in which no liver abscess could be demonstrated at the time of operation. Appended here are short résumés of the cases mentioned above:

Roch reported a case in which the liver abscess penetrated the diaphragm and chocolate pus was expectorated. Death finally occurred from exhaustion. At the autopsy there was only a cicatrix to show the site of the liver abscess. The entire base of the right lung was occupied by purulent cavities.

Suzuki mentioned a case of successful operation for hepatic abscess following dysentery. Eight months later an abscess formed in the upper lobe of the right lung, which was opened successfully.

Cantlie reported a case of successful operation on a liver abscess. Six months later empyema of the right pleural cavity developed. After draining, the patient died. Autopsy showed an abscess in the upper lobe of the right lung. The liver abscess had healed completely.

Godlee. Three such cases are reported by Godlee.

(1) Case 8.—A patient spitting up chocolate-colored pus was operated upon and an abscess in the base of the right lung opened. The finger was passed through the diaphragm into the abscess cavity in the liver. Two months afterward the patient died from haemoptysis. The autopsy showed irregular cavities in the right lung, but that in the liver had healed up.

(2) Case 9.—A patient with abscess of the liver began to spit up chocolate colored pus. Eventually, an abscess in the base of the right lung was opened on two occasions. Death occurred from abscess in the brain. The autopsy showed little or nothing to indicate the old abscess of the liver.

(3) Case 10.—A patient with abscess of the liver developed signs of an abscess at the base of the right lung. This was opened and drained. He eventually died from an abscess in his brain. The autopsy showed an extensive abscess in the lung, but nothing except adhesions between the liver and diaphragm to indicate the old abscess in the liver.

Marion reported a case of abscess of the lung, with profuse expectoration of pus containing no other organisms except amebæ. The patient had suffered from several attacks of amebic dysentery. Abscess of the liver was suspected but not found either by aspiration or at operation. Resection of ribs revealed adhesion of lung to diaphragm, but no abscess in the liver (compare our cases). An amebic abscess the size of an orange was found in the lower lobe of the right lung. The patient recovered.

Natton-Larrier reported a case of a patient with a history of dysentery, who developed an amebic abscess in the lower lobe of the right lung. During operation for draining the liver abscess, no affection of the liver was discovered. The patient recovered.

INFECTION OF THE LUNGS BY EMBOLISM

Compared with direct invasion, infection by this route is very infrequent. Many reported cases are open to serious doubt because of the carelessly conducted autopsies. Others must be accepted unequivocally.

The one reported by Colin is typical of this condition. A patient with abscess of the liver died with symptoms of intense dyspnea and asphyxia. The autopsy showed an abscess of the liver which had opened into the ascending vena cava. Scattered abscesses were found in both lungs.

Laferrére reports a case of abscess in the left lobe of the lung consecutive to one in the right lobe of the liver.

Bunting mentioned a case of amebic abscess of the liver with no involvement of the diaphragm or pleura, in which an abscess cavity was present in the upper lobe of the right lung. There were absolutely no signs of direct extension or communication between the two abscesses. On reflection it is rather remarkable that this mode of infection should be so rarely encountered. Perhaps the low intensity of the inflammation, the extent of fatty degeneration in the liver tissue surrounding the abscess cavity, and the frequent absence of microörganisms other than amebæ explain the rarity of embolism; or, on the other hand, it is probable that the lungs are particularly resistant to the invasion of amebæ under ordinary conditions. That under certain conditions amebæ do pass from the abscesses into the hepatic veins and into the lungs and even through their capillaries into the systemic circulation is shown by the appearance of cerebral abscesses of embolic origin, containing amebæ. One of our cases (Case X) at autopsy showed an abscess in each frontal lobe and in the left lateral cerebellar lobe. Many such cases have been reported.

Protherat reported a case of amebic liver abscess, with purulent expectoration also containing amebæ. The patient died with marked cerebral symptoms and the autopsy showed a brain abscess containing amebæ. Kartulis has stated that brain abscesses occur in 3 per cent. of all liver abscesses.

SYMPTOMS OF PULMONARY AND PLEURAL INVOLVEMENT

Added to the symptoms of hepatic abscess, the first sign of importance is severe pain in the shoulder. This is always a symptom of diaphragmatic involvement. It may be accompanied by increase in pain and tenderness over the lower part of the chest, which are suggestive of involvement of the lower portion of the pleural cavity. A distressing tickling or hacking cough may be present at this time, with or without any signs of pleural effusion. The symptoms increase in intensity until, without any other warning, the patient may expectorate suddenly a large quantity of chocolate-colored pus. Temporary relief of the symptoms follows and the patient may improve daily in health, if the drainage is free and if too much liver tissue has not been destroyed. When the drainage is free, pus flows without hindrance into the bronchi and is expectorated constantly. As time passes the quantity expectorated diminishes, and in some (rare) cases the abscess cavity may heal up completely and a spontaneous cure may result. In other cases drainage may be intermittent. Periods of profuse flow alternate with those of scanty flow or it may even cease for a time. During the periods of profuse flow the patient is free from pain and fever. When the flow ceases, pain and fever return again. In cases that drain poorly the outlook is serious, because the conditions favoring progressive necrosis of liver tissue are still present; and, further, the continued use of the lung as a channel for the discharge allows the amebic infection to gain a stronghold in lung tissue and to cause extensive destruction and cavitation.

The foregoing description applies to that class of cases where adhesions between the lung and diaphragm have preceded the pointing of the abscess. Where no adhesions have formed the abscess opens directly into the pleural cavity and fills it more or less. Signs of serous effusion often antedate actual perforation, in which event, except for an increase in the quantity of fluid, the physical signs do not alter. In such cases it is often impossible to

determine the time of actual perforation, symptoms of empyema being gradually added to those of serous effusion. The change in the character of the fluid is often discovered by chance after aspiration. In the event of perforation of the abscess into an intact pleural cavity (probably very rare) very acute symptoms come suddenly. Pain and dyspnea are intense. The whole pleural cavity may fill up in a very short time and the lung may be acutely compressed. If these cases are left to Nature and the pleural cavity is not drained, the outlook is very grave. Spontaneous evacuation of the accumulation may occur through the lung or through the chest wall. The former route is probably the most frequent. Even in cases that are drained, the mortality is very high. Pus is often discharged through the chest wall and into the bronchi simultaneously and in many instances drainage of the pleural cavity fails to relieve the expectoration completely. Some cases recover, but many of them die from exhaustion. Occasionally, cavities form along the drainage track in the lung in spite of external drainage, and from them pus of a chocolate color is expectorated constantly.

FREQUENCY OF PLEURAL AND PULMONARY INVOLVEMENT

This has been estimated variously by different writers.

Rendu, analyzing 563 cases, found 31 cases where the abscess had opened into the pleural cavity, or 5.5 per cent. Molinié stated that it occurred in 8.9 per cent. of cases; 5.5 per cent. for the opening of the abscess into the pleural cavity and 3.4 per cent. for the presence of serous effusion. Harris found the pleural cavity involved 3 times in 95 cases. Futcher, in 119 cases, found the lung involved in 6 and the pleural cavity in 3 cases. Strong, in 100 fatal cases, found the lung involved in 1 case and the pleural cavity in 2 cases.

Our cases show a marked contrast. In 27 cases we found the lung and pleural cavity affected in 11, *i. e.*, 40.8 per cent.

PROGNOSIS.—This can be more conveniently discussed under two heads:

1. The prospects of spontaneous cure.
2. The results of operative procedures.

1. *Spontaneous Cure.* This result may be hoped for in a small proportion of cases in which the abscess penetrates the lungs directly without infecting the pleural cavity, but it probably never occurs when the pleural cavity forms an intermediary channel between the liver and the bronchus. Quite a number of cases have been reported from time to time that can be accepted without cavil as instances of real cures. Such are two reported by Vertiz, where a period of good health had elapsed, without bad symptoms, long enough to justify the conclusion that the abscesses in both liver and lung had healed. Others cannot be accepted without question. Such are two reported by Philips, which were treated with ipecac and emetin, but were under observation too short a time to justify the conclusion that they were cured. It has been my privilege to see five cases where the abscess opened directly through the lungs. Of these only one certainly recovered (Case VII), not spontaneously, but following excision of the chest wall, and drainage of the abscess cavity. Another (Case VI) left hospital in thirty days, still expectorating chocolate-colored pus and having a septic temperature. A third (Case V) died in hospital four months after admission from exhaustion, spitting chocolate-colored pus to the last. The two others are not in the case reports, having been under observation prior to the year 1907. Both died eventually from exhaustion, with every symptom of pulmonary abscess, spitting chocolate-colored pus to the last. In only one, *i. e.*, the case that recovered, was the abscess located by aspiration. We failed signally to find the abscess cavities by the aspirating needle in all the rest.

2. *The Results of Operative Procedures.* The mortality of hepatic abscess in general is always high. Varonoff collected 1089 cases which were operated on in Egypt, during a period of twenty-five years, and found a mortality of 34 per cent. in those

operated on by a large incision, and a mortality of 60 per cent. in those treated with the trochar and cannula. Martin, in Camboge, found a mortality of 37.5 per cent. Gaide, in Toulon, found a mortality of 33 per cent. The best statistics on a series of consecutive cases is given by Cantlie. Out of 100 cases there were 82 recoveries and 18 deaths, a mortality of only 18 per cent. Of these cases 90 were treated by evacuation with a trochar and cannula (Manson's method). Our own mortality for the cases reported was, roughly, 29 per cent.

A separate analysis of the cases showing pleural and pulmonary complications reveals an enormous increase in the mortality. According to Molinié the mortality is as high as 84.8 per cent. Our own mortality for a consecutive series of cases amounts only to 45.4 per cent, but the number is small. It is my conviction that a mortality of 75 per cent. would represent an average. If every case leaving hospital could be followed up many of those discharged as improved would be found to have died of exhaustion. An analysis of our own reports will explain this statement.

I have made an analysis of our own reports since 1907, and find that 27 cases of hepatic abscess have been operated upon. The results I have tabulated very carefully are as follows:

Cured	13,	roughly	48 per cent.
Improved	6,	roughly	22 per cent.
Died	8,	roughly, a mortality of	29 per cent.

CONDITION OF THE 13 CURED CASES WHEN DISCHARGED

No. 1 was discharged in 30 days with normal temperature.
No. 2 was discharged in 21 days with normal temperature.
No. 3 was discharged in 40 days with normal temperature.
No. 4 was discharged in 3 months with normal temperature.
No. 5 was discharged in 2 months with normal temperature.
No. 6 was discharged in 49 days with normal temperature. (Case VII).
No. 7 was discharged in 3 months with normal temperature. (Case IX).
No. 8 was discharged in 44 days with normal temperature. (Case II).
No. 9 was discharged in 20 days with normal temperature.
No. 10 was discharged in 22 days with normal temperature.
No. 11 was discharged in 31 days with normal temperature.
No. 12 was discharged in 3 months with normal temperature.
No. 13 was discharged in 30 days with normal temperature.

None of these cases left hospital with any fever. Some had a slight discharge that required a dressing, but the condition of all of them was practically well. Of them three (Nos. 6, 7, and 8) were complicated with pus in the pleural cavity.

CONDITION OF THE 6 CASES MARKED IMPROVED WHEN DISCHARGED

No. 1 was discharged in 26 days. Temperature slightly elevated.
No. 2 was discharged in 24 days. Temperature septic, 99° to 102°.
No. 3 was discharged in 60 days. Temperature septic, 99° to 102°.
No. 4 was discharged in 30 days. Temperature septic, 99° to 102°. Spitting pus (Case VI).
No. 5 was discharged in 3 months. Temperature septic, 99° to 102°. Spitting pus (Case IV).
No. 6 was discharged in 36 days. Pleural cavity wide open and lung collapsed. Spitting up pus (Case XI).

It is evident that the condition of these patients was anything but satisfactory and some of them eventually died of exhaustion. There were *three* of these suffering from pleural and pulmonary complications (Nos. 4, 5, and 6).

DEATHS

TIME OF DEATH AND CAUSE OF THE 8 DEATHS

No. 1 died at the end of 4 months. Uncomplicated abscess. Died of exhaustion.
No. 2 died at the end of 48 days. Perforated diaphragm. Opened into pleura and lungs. Very septic (Case VIII).
No. 3 died at the end of 4 months. Perforated diaphragm and opened into the lungs. Exhaustion (Case VI).
No. 4 died at the end of 28 days. Infected pleural cavity. Exhaustion (Case III).
No. 5 died at the end of 66 days. Opened into pleural cavity, and lungs. Very septic (Case I).
No. 6 died at the end of 16 days. Uncomplicated abscess. Death from peritonitis, following perforation of ulcer in cecum.
No. 7 died at the end of 40 days. Pleural cavity and lung infected. Death from cerebral abscess (Case X).
No. 8 died at the end of 18 days. Uncomplicated abscess of left lobe of liver. Exhaustion.

It will be seen that five of the eight deaths (*vid.* Nos. 2, 3, 4, 5 and 7) occurred in cases where either the pleural cavity or

lungs or both were affected, *i. e.*, 62.8 per cent. of the deaths occurred in this class of cases.

Out of the 27 cases, there were 11 with *pleural and pulmonary complications*, *i. e.*, 40.8 per cent.; of these 5 died, *i. e.*, a mortality of 45.4 per cent

The following is a brief abstract of the cases:

Case I.—Male; white; aged forty-nine years. Abscess of right lobe of liver whch had perforated diaphragm. Pleural cavity full of pus. Also coughed up quantities of pus. No amebæ found. Drained with Manson's trochar; afterward excision of ribs. No abscess found in liver. Continued to spit up quantities of chocolate-colored pus even after drainage. Died of exhaustion at the end of sixty days (*vid.* No. 5, deaths).

Case II.—Male; aged twenty-nine years. Abscess of right lobe of liver. Lower part of pleural cavity full of chocolate-colored pus. Amebæ absent. Pleural cavity drained with trochar and cannula. Recovered (*vid.* No. 8, cures).

Case III.—Female; colored; aged forty years. Abscess of right lobe of liver. Right pleural cavity full of pus; chest wall edematous from fifth interspace down. Breathing labored. No spitting of pus. Pleural cavity drained with trochar and cannula. No amebæ found. Drainage free. Death from exhaustion in 28 days (*vid.* No. 4, deaths).

Case IV.—Male; negro; aged twenty-seven years. Abscess of right lobe of liver. Ruptured into the pleural cavity and lung. Spitting up of chocolate-colored pus. Amebæ present at first in sputum and in pus aspirated from pleural cavity, but disappeared during convalescence. Pleural cavity drained. Discharged from hospital in three months with septic temperature and wound in chest still draining (*vid.* No. 5, improved).

Case V.—Male; white, aged fifty years. Abscess of right lobe of liver, which had perforated into the right lung. Expectoration of chocolate-colored pus. Pleural cavity intact. Aspiration of liver failed to reach abscess cavity. Expectorated constantly. Died at end of four months from exhaustion. No autopsy (*vid.* No. 3, deaths).

CASE VI.—Male; white; aged twenty-eight years. Abscess of right lobe of liver. Perforation into the lung. Pleural cavity intact. Expectoration of chocolate-colored pus containing amebæ. An attempt was made to reach the pus with an aspirator, but it failed. Discharged from hospital in thirty days with septic temperature (*vid.* No. 4, improved).

CASE VII.—Male; white; aged forty-nine years. Abscess of right lobe of liver. Spitting up of chocolate-colored sputum, containing amebæ. Pleural cavity intact. Excision of seventh and eighth ribs. Diaphragm stitched to chest wall. Opened and drained abscess in upper part of liver. Cured in forty-nine days (*vid.* No. 6, cured).

CASE VIII.—Male; white; aged sixty-one years. Abscess of right lobe of liver. Perforation into the pleural cavity. Rupture into the lung and profuse expectoration of chocolate-colored pus. No amebæ found. Pleural cavity drained. Death in forty-eight days from exhaustion. No autopsy (*vid.* No. 2, deaths).

CASE IX.—Male; negro; aged thirty-five years. Abscess in right lobe of liver. Perforation into the right pleural cavity. Chocolate-colored pus aspirated from both situations. No amebæ found. Amebæ present in the feces. Pleural cavity drained after excision of part of the seventh and eighth ribs. Liver abscess drained through same opening. Recovery, in three months (*vid.* No. 7, cured).

CASE X.—Male; white; aged forty-six years. Abscess in right lobe of liver. Perforation into the right lung and pleural cavity. Spitting up of large quantities of chocolate-colored pus. Amebæ present in the pus. Amebæ also present in the stools. Pleural cavity full of pus. Drainage of pleural cavity by trochar and cannula, followed by great improvement in general symptoms. Subsequent excision of a large part of the bony wall of the right thorax. Lung collapsed. No abscess could be found in liver. Death in nine days. Liver abscess was practically healed. The lower lobe of right lung contained a large abscess cavity. Lung was collapsed (*vid.* No. 7, deaths).

Case XI.—Male; white; aged sixty-two years. Abscess of right lobe of liver. Perforation into right pleural cavity and lung. Expectoration of large quantities of chocolate-colored pus. Pleural cavity had been drained six months previously. Aspiration of cavity revealed chocolate-colored pus. Drainage with trochar and cannula. Slight improvement. Subsequent removal of a large part of the bony wall of thorax. No abscess was discovered in the liver. Lung was collapsed, but opening into it from pleural cavity could not be found; although fluid ran freely from pleural cavity into the air passages. Discharged from hospital in thirty-six days, with pleural cavity wide open and lung collapsed; also with expectoration of chocolate-colored pus (*vid.* No. 6, improved).

Treatment. Early diagnosis and prompt evacuation of the orginal abscess cavity is not only attended by a very low mortality, but is an effectual means of preventing these complications. A very large proportion of abscesses in the right lobe of the liver are capable of diagnosis long before they have penetrated the diaphragm, and they can be opened and drained with a trochar and cannula with every prospect of success. The cases that are difficult to diagnose and to reach with an aspirator are abscesses situated in the posterior and upper part of the right lobe near its junction with the left lobe. Some of them cause no local symptoms, except diffuse pain over the liver, until the diaphragm is involved, when pain in the right or left shoulder may be complained of. It is in such cases that sudden perforation into the lung and profuse expectoration of pus occurs so frequently. This accident sometimes happens without the patient knowing that he is suffering from liver abscess. Aspiration often fails to reveal pus in this portion of the liver, because sufficient care is not taken to search for it in the right direction and to a proper depth. Cantlie has given careful attention to the proper method of aspirating the liver and has formulated the following rules from measurements made on the cadaver. In a patient the circumference of whose body is 32 inches over the middle of the hepatic area, the vena cava inferior

lies at a depth of $4\frac{1}{2}$ to 5 inches from the surface of the body, along a line drawn backward horizontally (in the upright posture) from the xiphisternal articulation in front to the angle of the ribs behind. He also found that the vena cava is equidistant from any point in the usual operative area. Aspiration should be made systematically in a horizontal direction, penetrating the liver from the right to left, each successive puncture being posterior to the previous one. By this means, a larger area of liver surface is explored than can be done with punctures in different directions. Even after most painstaking and repeated aspirations, failures are very common and the abscess may eventually penetrate the diaphragm. The course to pursue after the abscess has penetrated the diaphragm depends on the pathological condition of the structures involved. *If the pleural cavity is not infected, i. e.*, if the lung has adhered to the diaphragm before perforation and the abscess has opened into a bronchus through lung tissue, it is better to wait awhile to see what will happen. Some few cases recover spontaneously. The liver abscess collapses and cicatrization follows, both in liver and lung. The result is only reached after a tedious convalescence and is probably a rare termination. What usually occurs is that the abscess fills up and empties itself intermittently, because for some reason the track through the lung becomes blocked or obstructed from time to time. A persistence of this condition is likely to terminate in infection of the walls of the pulmonary track with amebæ, which in turn will result in destruction and cavitation. Two cavities will then be present, one in the liver and the other in the lung, communicating with one another. Finally, that in the liver may heal up completely, but the cavitation persisting in the lung may extend and prove fatal. An accurate estimate of the true anatomical condition of the infected cavities is rarely possible. It is, however, necessary to bear in mind always that, at the time the case comes under observation, there may be no longer any abscess cavity in the liver. It is easy to understand why so many failures to reach the abscess cavity have been recorded. Even in cases where the abscess cavity in the liver still exists,

it is practically hopeless to reach it while expectoration is free and profuse, because the walls are collapsed and the cavity is very small. The only time when aspiration is justifiable is when the expectoration ceases and the patient is febrile (*i. e.*, when the abscess cavity is full). Even under these circumstances successful aspirations are rare. Still, it is probably the best course to pursue and repeated attempts should be made before abandoning this method as not feasible. If aspiration fails an attempt may be made to reach the collection (1) by the abdominal or (2) by the transthoracic route. The abdominal route is hardly advisable in abscess penetrating the right lung, because it is impossible to get within a reasonable distance of the point of perforation. Cantlie advises it strongly in abscesses of the left lobe. Through an incision in the left rectus the hand is thrust into the abdomen and the area of adhesion between the liver and diaphragm palpated. An aspirating needle is now thrust through the lower intercostal spaces in the direction of the abscess, being guided in its direction by the fingers in the abdominal cavity. The transthoracic route has been condemned because it may endanger the integrity of the pleural cavity. If conducted carefully by the method of Lannelongue, the cartilages of the seventh, eighth and ninth ribs can be removed and a large area of the upper surface of the liver uncovered by diaphragm can be rendered accessible. McLeod insists that a transthoracic operation is the only logical route, and bases his argument on the contention that the pathological focus in most cases is in the lung and not in the liver, because in this stage the liver abscess has healed up. It appears to the writer that this contention is well sustained by many postmortem examinations, and that well conducted transpleural operations offer the best prospect of ultimate cure. The cases reported by Godlee support this position strongly.

If the pleural cavity is infected the problem becomes less complicated. It should be opened at once and a drain inserted. If necessary a segment of one or more ribs should be excised. If the condition of the patient allows it, the upper surface of

the diaphragm should be examined and, if possible, the opening into the liver abscess found, enlarged if necessary and the cavity drained. Prompt attention will often save the lives of some of these patients. Collapse of the lung is often present and in old standing cases it is very unlikely that a great deal of expansion will follow even after decortication operations. A large number of these patients die sooner or later from exhaustion. In some instances the pleural cavity may contain pus which is being discharged into the lung and coughed up. As described above, the pleural cavity may be a reservoir and the lung tissue serve as a track or sinus along which the pus passes. On the other hand, the pus may pass from the pleural cavity into a lung cavity and thence into a bronchus. As previously stated, the liver abscess may be present or may have healed up. Such cases are almost hopeless. Even where no lung abscess is present the prospects of permanent cure are very slight. In the presence of a lung abscess, cure is very improbable. Still, we should do all we can. The lung abscess should be opened and drained; likewise, the liver abscess if it exists.

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A PRELIMINARY REPORT ON A METHOD OF TREATING EMPYEMA WITHOUT RESORT TO PNEUMOTHORAX

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Realizing that the treatment of empyema by thoracotomy is a violent procedure fraught with serious consequences, it occurred to me that some other method of treatment might be devised that would obviate the worst feature of thoracotomy, the shock of an acute traumatic pneumothorax, and otherwise possess equal or greater efficiency.

The proposed method contemplates the immediate substitution of a non-toxic and non-absorbable fluid of light specific gravity for the germ-laden pathologic product contained in the pleura.

The medium suggested belongs to the group of hydrocarbons and is commonly known as liquid paraffin or petrolatum, and may be used alone or charged with selected antiseptics. It is suggested for this purpose because of its chemical formula which, because it shows no oxygen content, proves its value as a medium hostile to bacterial growth. Being non-toxic and non-irritating it is believed that it will exert an emollient effect upon the inflamed serous membranes and shorten the period of inflammation.

Application of the Method and Technique. 1. The simple method of aspiration whereby, with the same apparatus, without pneumothorax, the pleural effusion is removed and the hydrocarbon preparation substituted for it.

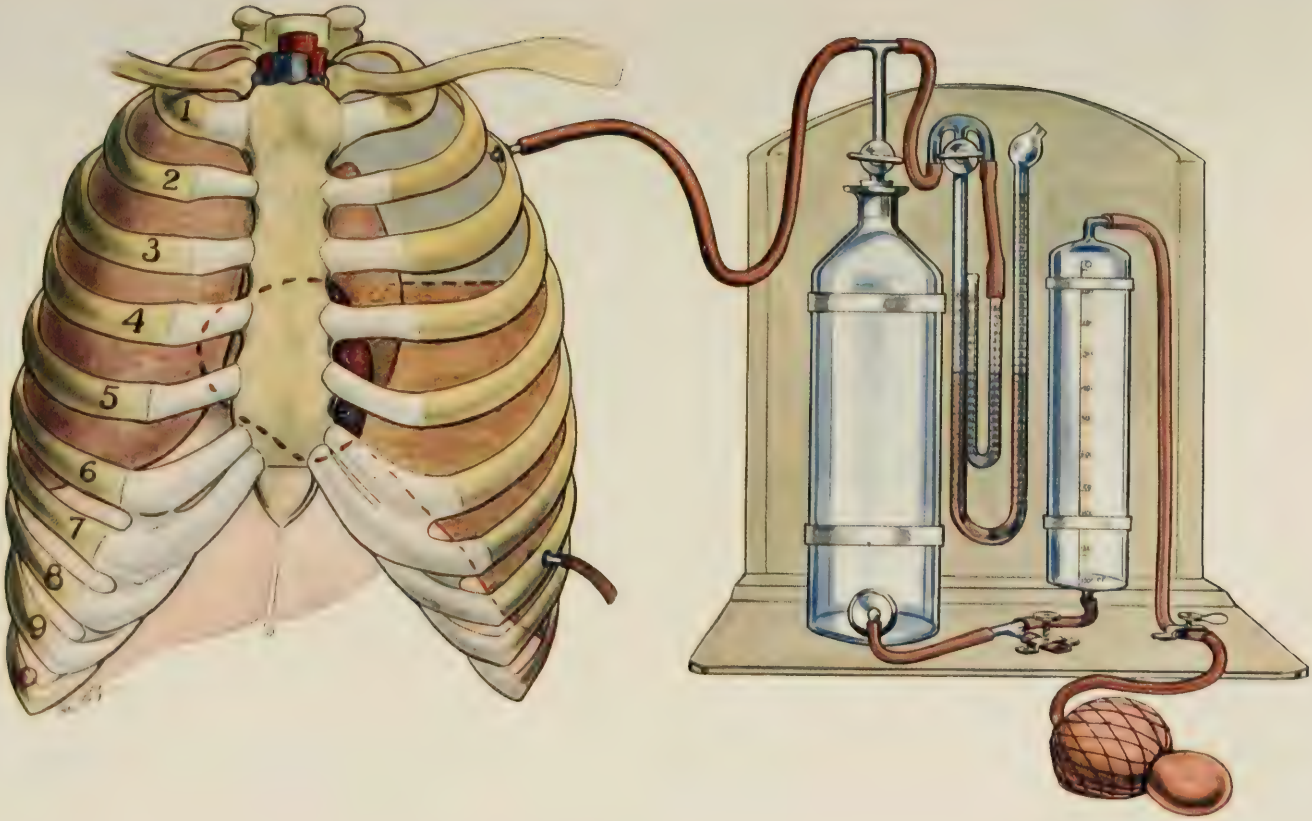
2. The utilization of the more modern apparatus and technique for closed artificial pneumothorax with manometer control.

3. A technique specially devised to permit ready and quick access to the pleura whenever required, the concurrent withdrawal of the pleural effusion through one channel and the introduction of the liquid hydrocarbon through another without pneumothorax.

Under this plan it is necessary to expose short segments of two ribs; one at a proper point a little distance below the upper level of the effusion and the other a little distance above its lower level. These two points must be carefully determined and verified by aspiration with a hypodermic syringe. The two exposed ribs are then trephined and a specially devised hollow screw of established caliber, its length approximating the depth of the rib, is driven through the rib without penetrating the pleura. If the symptoms be not urgent these screws can be left *in situ* for half a day or more so that they shall have about them a protective exudate.

Two cannulæ having now been provided which fit into the screws accurately, and which will later penetrate the pleura, that for the upper channel is armed with rubber tubing which connects it with a flagon containing the sterilized hydrocarbon at blood heat, while the other, also armed with rubber tubing, is either connected with an aspirator of the Potain or Dieulafoy type or simply immersed in a vessel containing water. The gravity plan operated slowly and carefully would seem to be the ideal method. Devices are provided which enable the operator to measure the outgo and intake which are controlled so as to be as nearly as possible uniform in flow and volume. This precaution is urged so that suction will not traumatize the delicate pleura.

The cannulæ now being made to penetrate the pleura the two currents begin to move and continue until the heavier and more dependent is exhausted. The light oil which floats high and caps the pleural effusion is displacing under light pressure the heavier fluid below which tends to escape by gravity. Ulti-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mately the flow of matter stops and that of oil begins; the oil has displaced the effusion and there is no pneumothorax.

The operation is completed for the time being by the withdrawal of the cannulæ. The lower is removed first and replaced by a small screw which effectually seals the channel. The two small incisions are then closed, a small gap being left to enable approach for the secondary procedure, and dressed properly. The symptoms are now observed from day to day, notably the temperature curve, the respiratory movement, the stereoradiographic findings, all governed by careful physical examination.

Should signs of stress develop at any time the complete plant can readily be replaced and quickly set in motion without anesthesia. The lower channel is first opened, and if pus be present it is withdrawn and, if need be, its equivalent of hydrocarbon introduced in the upper channel. The exigencies of the case might require one or two repetitions of the procedure.

Whenever it can be demonstrated that no more pus is forming, that the hydrocarbon alone occupies the pleural cavity, it may then be withdrawn. It is advisable to withdraw the fluid very gradually, from two to four ounces at intervals of two or three days, governed by *x*-ray examination until the pleura is free and occupied by a complete expanded lung. If there are any signs of irritation at this time the screws may be left in position or removed subsequently on evidence of their causing trouble.

The method, if finally approved by experience, offers the great advantage of relieving empyema without the shock of a traumatic pneumothorax; also the use of the hydrocarbon medium installs resistance to the prevailing bacterial activities, and being non-toxic and non-irritating when in contact with the pleural surfaces and holding them apart it may be relied upon to allay inflammation and prevent the formation of deforming adhesions.

The substitution of the hydrocarbon for the infective serofibrinous effusions in the early stages of acute pleurisy might

prevent not only progression to the purulent stage but also to the formation of deforming adhesions and those altered states of lung and pleuræ which tend later to tuberculosis.

Its use might readily be extended to the treatment of tuberculosis of the lungs when the compression and fixation of the lungs are desired as a means of curing that disease. In this connection it might be substituted for nitrogen gas because it is not absorbed by the pleura, whereas nitrogen gas is irritating, causes pleural effusion, and, because of absorption, has to be frequently replaced.

As a medium capable of conveying antiseptics in emulsion or solution when used in the treatment of the lung for compressive purposes a closer approach is offered through the bloodvessels and lymphatics for the therapy of the lung, and being a body of very light specific gravity, it will exert upon the lung a gentle, equable pressure and admit of a free degree of elastic recoil.

DOUBLE AND ANOMALOUS FORMS OF EMPYEMA

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In the year of 1899 the Oregon Railroad and Navigation Company began the construction of a short line between Riparia, on the Snake River, and Wallula, a distance of about one hundred miles. The line of construction followed the windings of the Snake River and was remote from any settlements.

Tent hospitals were provided at the terminals of the work, and a patrol service of three or four mounted surgeons was organized for the daily inspection of the camps. Provision was made for the transport of invalided employees to St. Mary's Hospital in Walla Walla, and St. Vincent's Hospital in Portland, Oregon.

Within three months after the work had begun a force of nearly three thousand men was engaged and distributed along the line of construction in the various camps. Accommodation for the laboring men consisted of the usual type of bunk-house, built of rustic and lined with felt, and in many of the camps, tents built on platforms furnished shelter. The problem of victualing the various camps was difficult because of the absence of roads; mules and horses were the only means of transport.

In the month of January an epidemic of influenza, which was pandemic, suddenly overwhelmed these camps, and within a week many of the laboring men were stricken with the disease.

In a very short time the limited accommodation on the works was crowded to its capacity, and the difficulty presented itself of conveying large numbers of invalided employees to the hos-

pitals. It became necessary to send them first to St. Mary's Hospital, Walla Walla, which was well occupied with its normal quota of patients at the time, and the overcrowding there soon made it necessary to transfer the stream of patients to the hospital in Portland.

Within two or three weeks there were invalided in the two hospitals between two and three hundred patients suffering from epidemic influenza, and a large percentage from pleuropneumonia of an unusually severe type.

Considering the indifferent accommodation of the camps, the poor shelter, the bleak country which had to be traversed in rough wagons, the limited supply of comforts, the heavy wind and sand storms which prevailed at that season of the year on the Snake and Columbia Rivers, and the long distances of train travel, it is not surprising that these men developed the graver forms of pleuropneumonia.

A review of the cases shows that more than half were those peculiar forms of pneumonia so often developed in association with influenza, namely, double and migratory forms of the disease. Drs. Shaw and Bingham, who had charge of the service in Walla Walla, treated in all 126 cases of influenza, 58 of which developed pleuropneumonia, many having double lesions of the lungs and pleuræ.

In my own service in St. Vincent's Hospital I observed a smaller number of cases of pleuropneumonia, but out of the number and my own private service, there developed 3 or 4 cases of double empyema.

The first case that I shall refer to was a German, thirty-four years old, suffering from double pleuropneumonia. Physical examination showed an effusion that extended to the level of the fourth rib on the right side, and to the eighth on the left. There were still signs of active pneumonia in the various stages of the disease. He was suffering greatly from air hunger and was deeply cyanosed. Aspiration of both sides proved the existence of a double empyema.

Realizing the urgency of the symptoms, I did what I thought

best at the time, and with limited anesthesia a double thoracotomy was quickly performed without rib resection and large perforated rubber drainage tubes introduced into both the pleural cavities.

I had never previously heard or read of simultaneous thoracotomy being performed, but followed what seemed to be the cardinal surgical indications, the evacuation of the abscesses. I felt very apprehensive about the patient, but was very much surprised to find his condition greatly improved within two or three hours after the operation, and the most impressive feature was the relief of the urgent dyspnea against which he was struggling.

His progress after the operation was extremely satisfactory, and his convalescence was complete after six or seven weeks.

The second case followed within two days, the patient having entered the hospital before Case I, suffering from double pneumonia of the peculiar type so general at the time. It seemed to spread from one lobe to the other without involving every part of each lobe. The physical signs were those of a frank pneumonia, and at the earlier stages the dry friction murmur of pleurisy was present on both sides.

The case was closely observed, and finally it was seen that an effusion was forming which progressed until it occupied the major part of the right pleura. There was evidence at this time of an effusion on the opposite side.

One day, finding the patient suffering from marked orthopnea, he was taken to the surgery. Following the methods in vogue at the time, I made an incision between the sixth and seventh ribs in the midaxillary line on the right side, evacuated a great quantity of pus, and inserted a rubber drainage tube. He was greatly relieved and his lung expanded very promptly, so that the breath sounds could be heard at the lower levels of the thorax. Observing now that the fluid was rising quickly on the left side, on the day following the first operation, having satisfied myself that it was purulent, I opened the pleura, evacuated the fluid, and inserted the same type of drainge tube. The pneumonic

consolidation of the lung resolved quickly afterward, the drainage abated, and within seven weeks he was safely convalescent.

The third case was a double empyema without physical signs of pneumonia. The case was observed from day to day for a week. Realizing that the level of the fluid was rising slowly but steadily on both sides, without, however, any untoward symptoms, I considered the case in relation to the first, and thought seriously of performing a simultaneous double thoracotomy, but decided that it would perhaps be safer to perform the operation in two stages. Thoracotomy was therefore performed on the right side and a large drainage tube inserted.

Stethoscopic examination the next day showed that the lung had expanded well and that air was entering readily into the deeper parts. Accordingly on the following day I performed a thoracotomy upon the left side, using similar drainage. The convalescence in this case was very striking; within less than three weeks the drains were removed and the patient ready to leave the hospital.

The fourth case in this group was observed by my colleague, Dr. E. E. Shaw, in St. Mary's Hospital, Walla Walla. A laboring man had pleuropneumonia and developed an empyema on the one side and a serofibrinous pleurisy on the other. The purulent effusion reached a moderate level and was relieved readily by thoracotomy and drainage. The serofibrinous effusion yielded to two or three successive tappings without becoming purulent.

The fifth case is reported by my friend and colleague, Dr. M. K. Hall, of La Grande, Oregon, then practising in Rainier, Oregon, during the period of the same epidemic.

February 1, 1899, C. S., aged seven years, French-Canadian descent, suffering from influenza and acute pleurisy. Under Christian Science treatment. Dr. Hall, summoned two weeks later, found the child *in extremis* and "seeming to get air enough to live, but no more." Hurried examination showed flat note on both sides over two-thirds of surface of each lung. Used trocar and withdrew a pint of pus from each side. The next day, with Dr. H. R. Cliff, of Portland, under ether anesthesia, I

incised the thorax between the ribs on both sides below the angle of the scapula; two rubber tubes were inserted in each side. Drainage, which was free, subsided after two weeks. Boracic acid irrigations were used each day; recovery complete and permanent.

The tapping of the pleura was an emergency measure; Dr. Hall had no other choice. With the greatest opportunities for deliberation he could not have improved upon his method of treatment.

The Anomalous Forms of Empyema. In this group I feel justified in first referring to a remarkable case which developed in my service in St. Vincent's Hospital in the year 1902.

For a time the railroad service employed on its right of way large forces of Japanese laborers who developed from time to time striking and unusual varieties of Oriental disease.

One of these Japanese, after rowing across the Columbia River in a boat, was seized by an acute attack of hemoptysis. He entered St. Vincent's Hospital, where he was subjected to a searching physical examination. Repeated microscopic examination of the sputum failed to reveal the presence of the tubercle bacillus, and no physical signs of pulmonary tuberculosis could be detected.

This man was under the direct observation of my colleague and associate, the late Dr. A. D. Mackenzie, who one day, while examining the sputum with a low-power lens found the ova of the lung fluke, Distoma pulmonum. Parasitic hemoptysis, although relatively prevalent in some of the provinces of Japan and the island of Formosa, had never previously been observed in Europe or America, and it fell to the lot of my esteemed colleague to make this original observation.

During the course of his stay in the hospital the patient developed acute symptoms suggestive of involvement of the right pleura. He had high fever, pain in the chest, and symptoms indicating an acute effusion.

I regret that I cannot refer to this case directly as an empyema, although I believe it was such. Unfortunately for the com-

pletion of our observations, when surgical treatment was being considered, fear of it prompted the man to run away from the hospital, and all our efforts to find him were unavailing, and we were thus prevented from treating a highly unique case of pleurisy which is known to be common in infections caused by the Paragonimus westermanii.

In this same Japanese service we had opportunities of observing many cases of beriberi and among the moist forms of that disease encountered several cases in which there were serofibrinous effusions of both pleuræ.

Three Cases of Putrid Empyema following Aspiration. Without going into detail the writer has observed three cases of putrid empyema, each clearly recalled and identified, the sequel of repeated aspirations of one-sided serofibrinous effusions with unclean instruments. It fell to my lot to perform the three operations. Hectic fever was present in all and signs of insidious constitutional infection. Although the outlook did not appear very bad, death followed promptly upon the operations, the symptoms suggesting a diffuse septicopyemic process.

One of these cases developed osteomyelitis of a rib which had been resected to allow free drainage; the process clearly extended from the resected end of the spine and required incision.

This experience prompted me to suggest in a short study at the time, that when rib resection was practised in thoracotomy the rib should not be crushed and cut as with the usual rib shears, but rather divided squarely with suitable saw, and always preliminary to the opening of the pleura after resection of the rib the divided ends of the ribs should be excluded from infection by covering them with their own periosteal flaps by suture, an interval of half a day or more being allowed before attacking the pleura for its evacuation.

A review of the literature shows that this type of infection is not only not uncommon but very serious when it develops.

I regard the record of these three cases as highly suggestive and important.

Among the very unusual atypical forms of empyema that I

have observed is one that was sent to my service in St. Vincent's Hospital by Dr. Pilkington, of Astoria, then of Antelope, Oregon.

In July, 1898, M. M., a Scotchman, aged twenty-eight years, much given to hard drink and contention, sustained a homicidal gunshot wound in the thorax and abdomen. A forty-four-caliber bullet entered the seventh interspace a little to the outside of the nipple line and emerged between the ninth and tenth ribs behind.

It penetrated in succession the chest wall, diaphragm, a coil of intestine, the diaphragm, pleura again, lung pleura, and chest wall, escaping between the ninth and tenth ribs behind. It was followed by collapse of the lung and fecal extravasation into the pleura and lung, which set up promptly a fecal pleuropneumonia, fecal pyopneumothorax and a fecal fistula through the diaphragm, lung, and chest wall.

By virtue of his sturdy Scotch ancestry and a rugged constitution the acute phases of these several processes subsided into a chronic stage in which there was left as a residue to be dealt with, a fecal fistula leading through the left lung, pleura, and diaphragm to the large intestine.

At this stage he was transferred to St. Vincent's Hospital and after a few days' rest he entered the surgery and submitted to the following operation: The ninth, tenth, and eleventh ribs were resected, sections of four inches being removed; the pleura and lung were then incised to the depth of the gap in the diaphragm. Strips of iodoform gauze were then thrust into the intestine in both directions to prevent soiling of the peritoneum. The adhesions between the intestine and the diaphragm were then carefully freed and strips of gauze packed into the peritoneal cavity to control leakage. When finally freed the loop of intestine was pulled through the lung and pleura and delivered through the fenestrum on his back and isolated with gauze. The edges of the wound in the intestine, which was two and a half inches in length, were then freshened and closed with two layers of Lembert sutures and replaced in the abdomen through the gap in the diaphragm and anchored there with one or two fine

sutures and a gauze drain placed *in situ*. There was no leakage afterward and recovery was complete, not even omitting his appetite for strong drink.

Case of pyopneumothorax following stab wound of the back complicated by gastric fistula through the pleural cavity.

On December 19, 1913, R. W., a patient of Dr. B. N. Wade, of Portland, had a wound three inches long inflicted below the scapula in the seventh interspace, the blade entering the pleural cavity on the left side. The wound was sutured without drainage by the house surgeon. The following day hemothorax was discovered. Wound was opened and drained. Two days later the drains were removed and the wound healed. Septic temperature developed later with bronchitis, biliary vomiting, tympanites, pain under left breast and in left shoulder at times.

Two weeks after injury severe chills and high fever; wound opened and drained. Two days later slight drainage of pus.

January 13. Drainage continued, septic symptoms subsiding.

January 22. *x*-ray showed pyopneumothorax. No pus from three aspirations of chest.

January 23. Rib resection; pus evacuated and adhesions broken down, liberating pus from pockets in pleural cavity; drainage free and copious.

January 30. Nurse observed food on the dressings, fish, eggs, crackers and all the water that was taken escaped from the pleura.

February 3. Drainage of food through the pleura continued; pain in the left breast more severe after eating. *x*-rays were made two minutes, ten minutes, half an hour, and six hours respectively, after bismuth gruel meal, and showed fistulous opening near cardiac end of stomach and bordering on esophagus.

Fed for five days after operation with water per rectum. When food was taken it all came through tube again. Pleural cavity packed to date and wound practically healed with granulation tissue.

Stomach symptoms are pain after eating and occasionally nausea and vomiting. Pain and distress seem to be at the cardiac end of the stomach. *x*-rays show part of the stomach

protruding into the pleural cavity through aperture in diaphragm. Case progressing favorably but still *subjudice*.

Chronic and Inveterate Serofibrinous Effusion of the Pleura Terminating in Chronic Empyema. The DeLorme Operation. This was a very striking case in which acute pleurisy was followed promptly by an effusion, which within three or four days completely occupied the pleura. Urgent symptoms demanded immediate operation. The fluid reaccumulated very quickly and with return of orthopnea required a second operation in a few days. This vicious circle continued for several weeks until a stage was reached when the effusion continued passive without causing symptoms other than moderate dyspnea.

From time to time afterward even moderate exertion would cause a recurrence of the urgent dyspnea and demand operation.

Every known method of medication was attempted without abatement of the effusion, and realizing that operative intervention was necessary for the ultimate relief of the case, thoracotomy was performed and drainage resorted to. The serofibrinous fluid finally became purulent under the stress of continuous drainage and the retracted lung refused to meet the shrinking chest wall.

Ultimately a thoracoplasty was performed, which, although it brought about great shrinkage of the thoracic wall, failed to relieve the condition. The large aperture enabled such inspection of the parts as to warrant the conclusion that the lung could not expand because of its fixation by dense and well-organized membranes which completely invested it and anchored it in the angle between the ribs and the spine.

Learning of the value at the time of the DeLorme operation through a study by the late Dr. William Jones, of Portland, I reopened the thorax and incised the dense coverings of the lung, which were as thick and tough as sole leather, stripped them right and left from the lung without excising them, and suddenly felt the lung forcing itself through the line of section until it occupied the entire space of the pleura. So great was the intrapulmonary pressure that the lung, for the moment, partially protruded through the gap in the thoracic wall.

Surgeon.	Date.	Published.	Own.	Reported.	Etiology.	Record.
Clot Bey	1834	Bluzat., Thèse Par., p. 60	...	x	.....	.....
Broadbent and Cheadle	1878	Med. Press and Circ.	x	..	.....	Pregnant fifth child
Sangster, J. T.	1880	Lancet, vol 2	x	..	Bronchopneumonia	.....
Blunt	1888	Lancet, vol. 2, p. 114	x	...	.....	Right apex pneumonia during convalescence
Gordinier, H. C.	1888	Med. Rec., N. Y., xxxiv. 177	x	..	.....	.....
Huber, Fr.	1889	Tr. Am. Pediat. Soc.	x	...	Double pleuropneumonia	Pus found 27th day
			x	...	Pleuropneumonia	.....
Hanson, D. S.	1889–1890	Med. Gaz., v, 322	...	x	Influenza and pneumonia	Ill 7 weeks before operation
Mitchell, Bruce, and Morgan	1890	Lancet, ii, 124	x	..	.....	.....
Batchelor, W. A.	1890	Med. News, Phila., lvii, 356	x	...	Bronchitis. Pain left side	.....
Westbrook, G. R.	1890	New York Med. Jour.	x	...	Pneumonia	Pus on 18th day
Coupland and Gould	1890–1891	Tr. Clin. Soc. Lond., xxiv, 79	x	...	.....	.....
Deanesley	1892	Lancet, i. 1299	x	...	.....	Ill 3 weeks previous to operation.
			x	...	.....	Pus found R. base but death occurred before 12th day after resection, another operation
Huber, Fr.	1892	Arch. Pediat., Mar., 203	x	...	Right lobar pneumonia	Tubes removed after 2 mos.
Hellin, D.	1893	Deutsche Med. Woch., No. 32, S. 768	...	x	Influenza and pneumonia	Localized areas on both sides
Beattey, E.	1894	Med. Jour., Durham, ii, 162	x	...	Cough, wasting and night sweats	Ill 3 weeks before operation. Recovery 2 months after operation
Fox, E. L.	1894	Lancet, Lond., ii, 384	x	...	Double pneumonia	60 oz. pus collected in abscess in buttocks.
Hensley and Dunn	1897	S. Barth.'s Hosp. Rec., Lond., xxxii, 213	x	..	Sore throat and cough	Extremely wasted before operation
Randall, M.	1899	Am. de Méd. et chir. inf. Par., iii, 180	x	...	Double pneumonia	Drainage tubes removed in 1 week
			x	...	Double pneumonia	.....
Hellin, D.	1901	Patecki Gaz. Lekarska	...	x	.....	.....
		Jaudenski und Sokotowski Gaz. Lekarska	...	x	Pneumonia. Serous pleuritis	Operation on 25th day
Angus, H. B.	1904	Med. Jour., xii, 172	x	..	Left-sided pneumonia. Pus contained encapsulated diplococcus	.....
Hellin, D.	1905	Jasinski. Gaz. Lebarska xxx, No. 6	...	x	Right-sided pneumonia	No anesthetic
Kerley, C. G.	1909	Treatment of Diseases of Children	x	...	.....	.....
			x	...	.....	Death 12th day after 2nd operation
Dubeyadoux	1910	Soc. de méd. mil. franc. Bull. Par., iv, 360	x	...	.....	.....
Gand and Poissonier	1911	Rev. gén. de clin. et thérap., xxv. 184	x	...	Grippe and left bronchial pneumonia	Abscess in left thigh and suppurative otitis media
Mackenzie, K. A. J.	1914	Am. Med. Assoc., New York	x	...	Double pleuropneumonia	.....
			x	..	Double pneumonia	.....
			x	..	.....	Drains removed 3 weeks and patient convalescent
			x	..	Pleuropneumonia and serofibrinous effusion	.....
				x	Influenza and acute pleurisy	.....
			27	7		
			34			

Age.	Sex.	Right side.			Left side.			Simultaneous openings.	Interval between operations. Days.	Cured.	Died.	Summary of operative procedures.						
		Aspiration.	Incision.	Resection.	Aspiration.	Incision.	Resection.					Aspiration only.	Aspiration and incision.	Aspiration and resection.	Aspiration, incision, and resection.	Simple incision.	Resection.	Incision and resection.
7	M.	....	x	...	....	x	..	..	30	x	..	..	...	...	..	x		
31	F.	x^1 x^3	..	...	x^2	..	..	..	1^1 6^2	x	..	x						
2	.....	....	x^1	...	x^2 x^3	..	..	..	5	x	..	..	x					
5 yrs. 9 mos.	M.	....	..	x^1	....	x^2	..	..	5	x	..	..	...	....	..	...	...	x
15	M.	x^1 x^3 x^5	x^7	...	x^2 x^4	x^6	..	..	1^1 1^2 14^3 1^5 9^6	x	..	..	x					
14	M.	x^1	x^3	...	....	x^2	..	..	6^1 2^2	x	..	..	x					
5 yrs. 6 mos.	.....	....	x^1	...	....	x^2	.	..	10	x	..	..	...	...	..	x		
19	M.	x^2	x^3	...	x^1 x^2 x^4	x^3 x^5	..	..	.....	.	x	..	x					
6	M.	x^2 x^5	x^6	...	x^1 x^3	x^4	..	..	7^4 6^5	x	..	..	x					
5	M.	....	x^2	...	....	x^1	..	..	15	x	..	..	...	...	..	x		
4	F.	....	x^1	...	x^2 x^3 x^4 x^5	x^6	..	..	6^1 6^2 9^3 16^4 24^5	x	..	..	x					
7	F.	x^1	..	x^2	x^3	..	x^4	..	9^3	x	..	..	...	x				
10	F.	x^3	..	x^4	x^1	..	x^2	..	1^1 5^2 5^3	x	..	..	...	x				
1 yr. 6 mos.	.....	....	..	..	....	..	x^1	..	.....	..	x	..	...	...	..	...	x	
6	M.	....	x^1	...	....	x^2	..	..	6^1	x	..	..	...	...	..	x		
13 wks.	.....	....	x^2	x^4	....	x^1	x^3	..	.....	x	..	..	...	...	..	...	...	x
1 yr. 9 mos.	M.	....	x^2	...	....	x^1	..	..	1^1	x	..	..	...	...	..	x		
12	F.	x^1	x^3	...	x^2	x^3	..	x	6^2	x	..	..	x					
4 yrs. 6 mos.	M.	....	x^2	...	....	x^1	..	..	5^1	x	..	..	...	...	..	x		
9	M.	....	..	x^1	....	..	x^2	..	14^1	x	..	..	...	...	..	...	x	
1 yr. 10 mos.	.....	x^1 x^2	..	x^3	....	..	x^4	..	7^1 5^2	x	..	..	...	x				
27	F.	....	..	x^1	....	..	x^2	..	8^1	x	..	..	...	...	..	...	x	
16	F.	....	x^1	...	....	x^1	..	x	.....	x	..	..	...	...	..	x		
17	M.	x^2	x^3	...	....	..	x^1	..	16	x	..	..	...	...	x			
7	.....	....	..	x^1	....	..	x^1	x	.....	x	..	..	...	...	..	...	x	
2	M.	x^1	x^2	...	....	x^1	..	..	4^1	x	..	..	x					
1	.....	....	x^2	...	....	x^1	..	..	3^1	..	x	..	...	...	..	x		
20	M.	x^2	..	...	....	x^1	..	..	8^1	x	..	..	x					
4	M.	....	..	x^3	x^1	..	x^2	..	.....	x	..	.	...	x				
34	M.	x^2	x^3	...	x^1	x^3	..	x	.....	x	..	..	x					
30–40	M.	....	x^1	...	....	x^2	.	..	1^1	x	..	..	...	...	..	x		
30–40	M.	....	x^1	...	....	x^2	..	..	2^1	x	..	..	...	...	..	x		
30–40	M.	x^2	..	...	....	x^1	..	..	.....	x	..	..	x					
7	M.	x^1	x^2	...	x^1	x^2	..	x	1^1	x	..	..	x					
1–7	2 F. 1 M.																	
7–15	2 F. 3 M.	15	22	9	12	23	10	5	1–24	31	3	1	12	4	1	10	4	2
15–30	1 F. 3 M.	7 females and 20 males.										2.94	35.29	11.76	2.94	29.41	11.76	5.88
30–40	2 F. 4 M.										9.68							

Small figures indicate sequence.

The value of this procedure appeared very impressive at the time, and was brought very forcibly to my attention again by a paper read in Los Angeles in 1911 (Surgical Section, American Medical Association) by Dr. F. B. Lund, a member of this Association, which must have had a very far-reaching effect in calling the attention of surgeons to the value of this operation in such cases and its merits superior to the mutilating operations of the Estlander and Schede types.

In 34 fully reported cases aspiration was performed fifteen times on the right side and twelve on the left. Incision was performed twenty-two times on the right side and twenty-three on the left. Resection was performed nine times on the right side and ten on the left.

Death resulted in 3 cases (9.68 per cent.) following three aspirations and two incisions on the left side and aspiration and incision on the right side (male, aged nineteen years); resection on the left side (infant, aged one and one-half years); incision on both sides (infant, aged one year).

Simultaneous thoracotomy was performed five times out of thirty-four, with recovery in each case (ages from seven to thirty-four).

Out of 125 cases reported by Hellin there were 37 deaths.

Out of 15 cases reported by Mackenzie there was one death. Mortality in total of 140 cases was 38, or 27.14 per cent.

Out of 77 cases (Hellin, 62; Mackenzie, 15) the ages were 56 between eight months and twelve years; 3 were fifteen years; 4 between sixteen years and eighteen years; 4 between twenty years and twenty-three years; 3 between twenty-seven years and thirty-one years; 4 between thirty-four years and forty years; 1, forty-four years; 1, fifty-two years; 1, fifty-three years.

Out of 62 cases (Hellin, 32 males, 17 females; Mackenzie, 13 males) 45 were males and 15 females.

VISCERAL PLEURECTOMY

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Chronic empyema is a condition which is quite common in spite of the fact that it results, in most instances, from the failure of early diagnosis and the establishment of sufficient drainage in the acute stage. In the acute stage, if free drainage is established early and the adhesions broken up at the time of the first drainage, the lung re-expands quickly, thus obliterating the abscess cavity, and the patient goes on to rapid recovery. In the neglected case in which the infected fluid remains in the pleural cavity for a considerable length of time, the pleura becomes so thick and fibrous that even after free drainage is established, the lung cannot re-expand. In nearly all cases this is because of the adhesions and the thickened pleura, and not due to any extensive disease of the lung. It is true that in some cases there is an abscess in the lung which drains spontaneously into the pleural cavity, but this does not seem to be the usual way in which an empyema takes place.

In the chronic cases of empyema the ribs prevent the chest wall from dropping in and the adhesions and the thickness of the pleura prevent the lung from re-expanding. The result is a large cavity which continues to discharge varying amounts of pus. Nature cannot obliterate this cavity, as she ordinarily obliterates cavities, by collapse of the tissues about it. Neither can she force granulations through the fibrous wall of the abscess.

Various methods have been devised by surgeons to obliterate this cavity. Estländer[1] resected the ribs subperiosteally over the entire area. The number of ribs resected varies with the size of the cavity. It is important to be radical and to resect one rib too many rather than one too few in order that no dead space remains in the upper or lower part of the cavity to continue suppuration. Many surgeons have modified this operation; for example, Wagner,[2] Sauboutin,[3] Beck,[4] Quenu,[5] and Tietze,[6] resected small portions of the ribs through parallel and vertical incisions of the region involved. Jaboulay and Leymarie[7] divided the sternal attachment of the ribs, making use of the articulation at the vertebral column to mobilize the chest wall, while Boiffin[8] recommends resection of the ribs close to the vertebral column, making use, as it were, of the mobility of the costal cartilages. More recently, Wilms[9] has combined these two operations and resects a couple of inches of several ribs along the spine and also along the sternum in order to mobilize the chest wall. Schede[10] noticed that some empyema cavities did not heal even after extensive resections of rib. He observed that the thickened pleuræ did not unite with each other but directly impeded recovery. Consequently, he devised the operation which bears his name. This consists of removing not only the ribs covering the empyema cavity, but also the thickened parietal pleura and the intercostal muscles, so that the skin and superficial muscles rest directly against the thickened visceral pleura. This operation is usually performed through a U-shaped incision beginning along the external margin of the pectoralis major muscle to the lower part of the thorax and then backward and upward to the median line of the scapula. The skin, superficial muscles, and scapula are then reflected upward, while the pleura, ribs and deeper muscles are removed over the entire cavity. The operation is severe and the shock to the patient is often alarming if not fatal, especially since many of these patients are in an extremely debilitated condition.

In 1893, Fowler,[11] operating on a woman thirty-five years of age who had an empyema with a fistula for ten years, dis-

sected out the scar tissue surrounding the fistulous tract and removed the entire mass of fibrous tissue from the diaphragm and lung. He was surprised to discover that the lung began to re-expand as soon as this thick scar tissue was peeled from it. The patient recovered from the operation and the wound entirely healed within a few weeks. The case was reported in December, 1893. In commenting on the case, Fowler stated that the history suggested a method of dealing with some of the cases of old empyema with a persistent sinus which resists all the means usually employed for their cure.

De Lorme,[12] after observing autopsy cases of old empyema, decided that the lung would re-expand if the thickened pleura was removed from it. Consequently he devised the same operation and reported it about three months later, in the early part of 1894. Unfortunately his patient died from hemorrhage and shock.

These two men performed the same operation and arrived at the same conclusions concerning these cases, the difference being that one of them performed the operation, following out the steps as he proceeded, while the other studied out the operation in advance and then performed it. Ransohoff,[13] following the work of Fowler and De Lorme and appreciating the difficulty of removing the thickened pleura in some cases, advised making multiple incisions at right angles to each other about a quarter of an inch apart, through the thickened pleura down to the lung, so that the entire visceral pleura should be gridironed. This is a valuable procedure and may often be used with good results in conjunction with visceral pluerectomy.

We believe that the operations of Fowler and De Lorme have not received the attention from American surgeons which they deserve. We have been able to find but twenty-four cases reported in the literature by three operators in the twenty years that have elapsed since the reports of Fowler and De Lorme. The efforts of surgeons up to the time of their reports had evidently been directed entirely to obliterating the cavity in chronic empyema by collapsing the chest wall. They apparently

have not appreciated the fact that in most instances the lung itself is not badly diseased and that it will re-expand to a greater or less extent if given an opportunity. Even today the possibility of restoring a portion or even an entire lung to the patient is not fully appreciated. In this age of conservation it certainly seems worth while to attempt, even if we do not always succeed, to restore to the patient the use of a portion of such a valuable organ as the lung.

Keen's *Surgery*[14] states that as a rule satisfactory results cannot be expected by this method if the operation is undertaken after four or five months have elapsed since the primary drainage. Von Bergmann's *Surgery*[15] tells us to try decortication of the lung when other methods fail. If it is possible for the lung to re-expand in a reasonable proportion of the cases without involving more danger to the patient than by other methods, we accomplish everything that is accomplished by the other methods and, in addition, restore to the individual the use of a lung or portion of a lung. This factor certainly seems important enough to be considered seriously. In previous years the results from the Estländer and Schede operations were so discouraging that, through a process of evolution, we have gradually taken up the operation of visceral pluerectomy in conjunction with these other procedures.

We wish to report two cases in which this thickened pleura was removed from an entire lung in an adult, in both cases more than six months after a primary drainage.

Case I (No. A31028).—Male, aged twenty years. Date of operation, November, 1911. Patient had had typhoid fever. Sick for three months following the typhoid when an empyema was discovered on the right side and drained. This was in January, 1908. This had been draining at intervals until he first came under observation. Examination revealed a nearly collapsed lung on the right side, with an enormous cavity which extended from the diaphragm to the clavicle. Through an opening large enough to explore the cavity, the thick, fibrous pleura over the entire lung was removed. There were a number of fibrous bands

which entered into the tissue of the lung and others that bound it to the diaphragm. These were freed as well as possible. The case was considered very unfavorable after the operation was finished. To our surprise, the lung soon filled the entire thoracic cavity and drainage was entirely stopped by January 5, 1912, fifty-one days after the operation. There were good breath sounds over the entire right thorax, the patient steadily gained in health and strength and has remained entirely well to the present time.

Case II (No. A77103).—Male, aged twenty-three years. Examined December 7, 1912. Was shot with a rifle through the left chest in October, 1912. Bullet entered in front, passed entirely through the thorax and was found lodged under the skin of the back. Three weeks later an empyema was drained. When examined in our clinic the left thorax was shrunken, the patient was very weak and emaciated and the entire left lung collapsed. He was advised to return to his physician to get in better condition to undergo a pleurectomy.

Six months following the primary drainage, in May, 1913, he returned for operation. A complete visceral pleurectomy of the left lung was made. The thickened pleura was removed from the lung, diaphragm, and pericardium as well as possible. There was very little bleeding and, although the patient was emaciated and weak, there was almost no shock following operation. Drainage ceased entirely in three months. There were good breath sounds over the entire thorax and the patient had gained nineteen pounds in weight. Two months later the patient returned with a small collection of pus in the pleural cavity under the left axilla. This was drained. The patient still has a small cavity at this point which will require further operation, but at least two-thirds of the lung is functionating.

These two cases illustrate the possibility of a collapsed lung re-expanding even after many months. We do not intend to say that such results can be accomplished in every case of chronic empyema, and we realize that pleurectomy must be combined with resections of rib and the Ransohoff technique in most

instances. What we wish to emphasize is the fact that in our experience pleurectomy has not produced anywhere near the same degree of shock that the Schede operation does. We believe that in most instances it should be attempted before extensive resections of rib are undertaken. If the lung only partially expands, resections can be done at a second operation without any loss except the time of the patient.

Tüffier[15] recommends that with the patient in poor condition the operation be divided into several stages, rather than attempting to complete it in one stage. He also recommends the De Lorme operation in selected cases. We also believe that many of these cases should be operated upon in stages, and pleurectomy can be attempted. If this does not obliterate the entire cavity, one usually gains some of the lung expansion and the remainder of the cavity can be obliterated later by the Estländer or Schede operation.

We wish to report two other cases in which the wound healed primarily following pleurectomy.

Case III (No. A71074).—Male, aged twenty-two years. Patient with a left-sided empyema following pneumonia, which had drained at intervals for thirteen months. A cavity six inches in diameter posterior to the pericardium was explored and the thick membrane covering the pleura and diaphragm removed. The cavity healed entirely in thirty-nine days.

Case IV (No. A73419).—Male, aged eighteen years. Patient had a left-sided empyema which had drained for over two years. At operation a cavity the size of a large grape-fruit was found external to the pericardium. The thick membrane was peeled from the lung and partly from the pericardium. The cavity closed in three weeks.

In discussing the treatment of such cases, a word should be said in regard to the preparation of the patients for operation. Many of these patients are as much in need of preoperative treatment as patients about to undergo an operation for prostatectomy.

It is very important that the drainage should be at the most

dependent part of the cavity. We have seen several patients gain from fifteen to twenty-five pounds in a few weeks with a corresponding gain in strength by changing the point of drainage to the most dependent part of the cavity. Autogenous vaccines

FIG. 1.—Before operation.

should also be employed. After the patient has stopped gaining, following such an operation for drainage, and is in the best condition possible, irrigation of the cavity twice daily with a weak iodine solution helps reduce the infection to a minimum. In regard to the operation itself, sufficient exposure must be

obtained to make every portion of the cavity freely accessible. The entire cavity should be cleansed as thoroughly as possible and then swabbed with strong tincture of iodine before pleurectomy is begun. The incision through the thickened pleura is best started posteriorly along the vertebræ, as there is less danger,

FIG. 2.—Before operation.

especially on the left side, of entering the pericardium. One need not fear slitting entirely through the thick pleura down to the healthy lung, as the bleeding does not seem to be excessive, and, although the lung has been injured enough to allow air bubbles to escape, in almost every instance no harm has arisen from such injury and apparently no extensive infection to the lung by such

exposure has occurred. Pneumonia has not occurred in any of the seven cases in which pleurectomy has been performed. Abundant drainage to the furthest points of the cavity should be provided for by small gutta-percha drains to prevent reaccu-

FIG. 2*a*.—Some weeks after operation, showing reëxpansion of major part of the lung.

mulation of the fluid in the pleura. One operative death has occurred in this series. With our present knowledge we believe that too extensive an operation was attempted on this case. Now we divide the operation into stages when necessary.

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DISCUSSION

Dr. Fred B. Lund, Boston.

In 1910 I reported seven cases of pleurectomy, and I believe anyone who has done that in an old case of empyema and had the case get well will realize what a wonderful procedure it is. It would be ideal if we did not have to drain afterward so we could seal the chest air-tight. The lung seems to adhere to the chest almost by first intention in some cases; but in others you must keep up the drainage and even later may have to do a rib resection.

I have had a number of cases since that report, and I have been able to modify Dr. Ransohoff's procedure by leaving on some little patches of pleura, through which in suitable cases sutures may be passed to hold the lung to the chest wall. In operating for localized empyema, one need not peel off the pleura beyond the limits of the cavity. If you peel off where adherent to the chest wall, you let air into the fresh pleura, and you may get more compression on your lung, with complete collapse. If the membrane is peeled off over the lung surface and no more, the internal pressure acting on the elastic tissue will give perfect expansion.

I was interested in Dr. Beckman's bullet case. In these cases, the chest fills first with clotted blood, which later becomes infected, and the adhesions and pleural membrane are very firm indeed. I want to call attention to the importance of this operation in children, because if you do an Estländer or Schede and take out larger portions of the ribs, you invite curvature of the spine; but if you can make the lung expand, you will find a straight back as the child grows older.

In regard to local anesthesia in ordinary empyema, it is very valuable. Some of my cases were made necessary by inadequate drainage for empyema. Where you trephine the rib and put in a small drain, you will not obtain satisfactory results; nor even where you put in a large tube. What you want is a large hole for the pus to come out, and a long flap to come down over it so that air cannot get in. I have used the skin for this flap recently, making the incision in the skin over the rib below the rib taken out, suturing the tube to the lower lip of the incision, and cutting the ends of the tube on a slant so that the upper end is absolutely flush with the inside of the chest. Thick pus will lift up the lid and run out, and when the chest expands the flap comes down over it and prevents air getting in. It is very simple and does no harm. It seems worth general trial.

Dr. Charles N. Dowd, New York.

The topic, lung decortication, is a timely one. Fifteen of the twenty-four reported cases to which Dr. Beckman has referred were my own cases, and I have done others since those reports were made. Fortunately I have been able to follow many of these cases for several years.

The status of the operation is not yet determined; naturally the best reports come from operations on lungs which are not extremely compressed. In reading such reports or in seeing such patients one naturally wonders whether the lung might not have expanded without this operation. At all events by the aid of *x*-ray pictures taken from time to time one can watch expansion slowly take place in lungs which have been considerably compressed. It is fair, however, to believe that decortication is helpful in certain cases in whom lung expansion is very slow and uncertain.

But it is for the extreme cases that we specially need relief, the cases where the compressed lung is held firmly against the spinal column, a contracted mass with very slight respiratory power. In dealing with these cases there will be many disappointments. If one cuts down on these lungs the pulmonary pleura can usually be separated from the compressed lung. The lung will then expand to a certain degree. If the anesthesia is withdrawn and the patient coughs, this expansion will seem most encouraging just as De Lorme said it would. It is, however, easier to obtain the expansion than to maintain it. In at least three instances I have had to do secondary operations months or years after the primary operations, and have been much disappointed to find that the lungs had shrunken again and that there had really been no gain in breathing capacity. Most of the cases, however, were cured in the sense that their sinuses were closed, their spines were erect, and their health good. These results, however, were due to the extensive thoracoplasty which was done rather than to the lung decortication. One may be warned against believing that satisfactory lung expansion has occurred because good breath sounds can be heard on the affected side; these sounds may be transmitted from the sound side, and on operation the lung may be found to be much smaller than auscultation would lead one to expect.

In the discussion today I think the dangers and difficulties of the De Lorme and Schede operations have been magnified. We may remember that in these patients there is usually a cavity or sinus which extends to the apex of the chest. In adults the cavity is frequently of large size, but in children it has usually contracted to a

sinus an inch or so in diameter. This result is due to the contraction of the chest wall and the thickening of the costal pleura. There is a method of approaching this sinus or cavity without giving the patient much danger or shock. This approach lies in the anterior axillary line; through this approach a large triangle of chest wall can be removed without encountering important structures or meeting severe hemorrhage. Among my cases there has been only one operative death, and it is doubtful if that would have occurred if the patient had remained in the hospital.

Dr. Alexander Primrose, Toronto.

I wish to refer to an experience I had which illustrates the value of the operation suggested by Dr. Beckman in his paper. That is the case of a man who came with a pyopneumothorax, with extreme emaciation and copious discharge, emitted both from a sinus in the chest and by coughing up material through the air passages. I undertook to do an extensive Schede operation and succeeded in carrying him through this ordeal successfully. He made a complete recovery. The wound healed nicely, the discharge ceased, and he gained weight rapidly, and returned to his work as a motorman on the street railroad. He continued at work for some two years, and then was unfortunate enough to contract pneumonia, from which he promptly died. A postmortem was conducted and we found a condition similar to that described by Dr. Dowd in his cases. There was very little functional lung on the side where the operation had been performed; there was a large amount of fibrosis with a very small amount of functionating lung tissue.

It is obvious, if it be true that after resection of the visceral pleura the lung is capable of expanding, that individuals subjected to such operations are in better condition to withstand an illness such as my patient had, because he would have some healthy lung substance on the side upon which operation had been performed and this circumstance might possibly be sufficient to make recovery possible in the event of an attack of pneumonia.

Dr. Leonard Freeman, Denver.

I merely wish to present a photograph showing the ultimate result of a very extensive Schede operation. It is of interest simply because it is a stereoscopic photograph. It enables one to compare the extreme deformity following these mutilating operations with the more satisfactory results obtained from visceral excision of the pleura. (Presented stereoscopic photograph of patient upon whom an extensive

Schede operation had been performed. The entire right side of the chest was absent, the shoulder projecting out prominently over the great cavity beneath.)

Dr. R. Hamilton Russell, Melbourne, Australia (by invitation).

From my practice in Australia I would like to make a suggestion which may be of some service to my medical friends in this country. As to the great danger of opening the pleura suddenly as distinguished from lesser procedures, such as making injections into the pleura, too much stress is laid upon the fact of opening the pleura widely. In Australia we have experience with a class of cases in which extreme danger is attendant upon very slight procedures applied to the thorax. It is noticed that in cases of hydatid of the chest that extreme danger and sudden death are liable to attend a slight procedure such as diagnostic puncture. It might at first sight appear that the explanation was that hydatid fluid was permitted to escape into the cavity from the hydatid, then into the bronchus, and so drown the patient. The explanation is, however, still to be sought. It is a nervous phenomenon from effect on the vagus. It is not a question of drowning the patient, but it will occasionally happen in cases of hydatid of the liver. I have myself seen a man reduced to the most dangerous collapse in the consulting room of a surgical friend as the result of putting a hypodermic needle into a large hydatid of the liver. With regard to this question of hydatid I mention it, not because it is frequent in America, but because it may occur in any American hospital or to any American surgeon. Apart from the question of hydatid it it also well known that sudden death is liable to occur from apparently very slight causes when the chest has been subjected to such a procedure as syringing out the pleura.

Dr. Frank E. Bunts, Cleveland.

I am interested particularly in the paper of Dr. MacKenzie regarding the double empyema, and I was very much in hopes that Dr. Murphy would say something regarding it. If I am not mistaken, a few years ago Dr. Murphy gave us an interesting account of treating some of these cases by injection of formalin without the necessity of opening the thoracic cavity, and I was wondering whether in double empyema where there is presumably danger in opening both cavities at once, whether if we opened one we could not inject the other with the formalin solution. I recently had occasion to operate on a child, aged thirteen years, for appendicitis and subsequent pleuropneumonia, then empyema, which I opened and drained, and the child

then developed an empyema on the other side. I was afraid, not knowing the good results which Dr. MacKenzie has spoken of in treating both sides at once, to open the other side, and advised the injection of formalin and glycerin; this was done, but the pus continued and on account of the embarassed respiration it was necessary to aspirate that side every day for several weeks until the side which was draining closed. Then I resected the rib and drained the other side. The patient made a satisfactory recovery.

Dr. John B. Murphy, Chicago.

In reply to Dr. Bunts' question, I would say he is quite correct in saying that I did recommend this plan, and I still continue to use the plan; I never open a closed empyema without using the formalin glycerin injections first, and I rarely have to open them after using it.

I never use it where the empyema communicates with the bronchus, and in postpneumonia empyemas, if treated early, one to three injections are sufficient. I have not had any untoward accidents from it. I was surprised in reading Brewer's comment in Keen's *Surgery* to find he had learned of two fatal cases. I wish to mention this point particularly as it does not agree with my experience, nor does it seem justified. However, injection and aspiration of the chest should be made only by those who have a clear knowledge of the elementary principles of surgery of the thorax.

Dr. James E. Thompson, Galveston (in closing).

I want to emphasize one point only in reference to my paper, which is that the constant spitting up of chocolate pus must not be considered sufficient evidence that an abscess is still present in the liver. In numbers of cases, chocolate pus is expectorated constantly for a long time, and when they come to postmortem, a cicatrized area in the liver is the only focus that represents a liver abscess. Chocolate-colored pus is produced by disintegration of the lung, resulting from amebic infection, in the same way as it is produced in the liver.

Dr. K. A. J. Mackenzie, Portland, Oregon (in closing).

The addition of the latter part of my paper was an afterthought and I had little time to make an extended study of experimental work, but I had an opportunity to do a little. So in the department of pathology in the University of Oregon, with the little time at our disposal, with the aid of Professor R. L. Benson, head of the department, Professor Dillehunt, professor of anatomy, and Dr. Ralph Matson, a series of experiments were made upon guinea-pigs and dogs. In the case of five guinea-pigs in which liquid petroleum was

injected into pleura by Dr. Matson, at the end of five days there was no evidence that the petroleum had set up any inflammation of the pleura causing adhesions or that there was any evidence of absorption of the oily medium. The experimental work on dogs unfortunately failed. The first one died under a deep anesthesia in the midst of the operation. The second, because of faulty technique, died and at postmortem showed extensive infection in both pleuræ.

Dr. Charles H. Mayo, Rochester, Minnesota (in closing).

The discussion of these cases of old chronic empyema with fistula has been most interesting. Dr. Murphy has mentioned an important point: that is, what to do with the early cases. His method of injecting the pleural cavity to stimulate repair has much to recommend it. Children sometimes get well after one or two aspirations which may cure pneumococcic empyema. It would be interesting in the present discussion to consider some of the various methods of drainage and continuous aspiration with vacuum suction to prevent shrinkage of the lung and cause large cavities which require such radical procedures for relief.

Dr. Joseph Ransohoff, Cincinnati.

In this discussion of thoracic surgery I am reminded of the Apostle's saying that the first shall come last and the last shall come first. Therefore the last thing to be discussed is really the most important, namely, the condition which occurs oftenest in the chest, ordinary effusion, the result of either tuberculosis or infection of some other kind. Now, we all speak glibly of the ease with which the thoracic cavity can be opened. And we speak of the safety with which the thoracic cavity is opened. The thoracic cavity cannot be opened like the abdominal cavity, not simply because of greater danger of infection, but because of the actual shock accompanying the opening of the thoracic cavity for such a small thing as aspiration or thoracotomy. In my own service I know of two deaths on the table from simple thoracotomy, deaths that occurred without premonition under general anesthesia. Quite recently one of the most interesting things published has been fatalities that have occurred after ordinary drainage operations, a collection of 70 or 80 cases reported by Sassas. When we have such things after simple thoracic operations we cannot speak of thoracotomy as being innocuous. What is it that causes death in empyema from ordinary drainage? I should say there is an enormous degree of shock in the opening of the chest cavity under most conditions. How can this be avoided? There is no place in the whole anatomy where the use of a knife is more likely to be followed

by shock than in the chest, and if there is anywhere that anoci-association is indicated it is here. I believe there is no single place in the whole economy where it is more essential that we should get into the way of opening the chest under local anesthesia. It is a long time since I opened the chest except under local anesthesia, and I have had really none of these alarming symptoms which appear when general anesthesia is used.

Now with regard to the ordinary aspiration. That certainly is a simple procedure and there is no one who has not known upon his service internes saying, "I was unable to remove all the fluid because after a pint or two was removed coughing and pain seized the patient and I had to stop." That, of course, is not connected with empyema, but it is an analogous subject and might be touched on. Why do the patients cough? It is exceedingly likely, the fluid escaping by aspiration, that the lung is drawn upon where the adhesions are firm and that irritation causes the pain and coughing. It is not unlikely, in other words, that the too rapid removal of the fluid is detrimental to such an extent that the removal of the fluid must be interfered with. One of the most admirable additions to our treating these simple cases is that of Hobben of not aspirating the fluid but of blowing it out. The method has been indicated by Dr. Mackenzie today. Two apertures are made, through the lower end of which a cannula is introduced and the air is pumped out by fluid; when that is done one leaves a pneumothorax which will take care of itself. In children particularly we know that the ordinary empyema operation is very rapidly followed by expansion of the lung and recovery, but that is not true of infants, and in these I certainly think it is wise still to resort once or twice to aspiration with the injection of some sterile or antiseptic fluid.

The last essayist alluded to an operation I devised some seven to eight years ago, discission of the pleura. It struck me at the time as being the right name for it. It is an operation like so many others that one makes because he cannot continue with an operation that he originally set out to do. It was in a case of empyema of long standing in which I did a pleurectomy, but there was so much bleeding and the difficulties of dissection were so great, and then with one incision I seemed to see the incision in the pleura grow larger, and I could see the bluish lining through. I made half a dozen such incisions in one direction and the same number in the other direction, and was surprised to see how these scar areas grew smaller. How to designate this modification of the De Lorme-Fowler operation gave me some difficulty until I remembered the operation of the ophthalmologists known as discission.

THE SURGICAL ASPECTS OF BRONCHIECTASIS

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It is rather extraordinary that three contributors to this important symposium on thoracic surgery should have chosen independently to discuss bronchiectasis—a disease with high mortality in surgical annals, and one admittedly chronic from the point of view of the internist.

The importance of a disease should be estimated quite as much by its disabling power as by its mortality. Probably our interest in bronchiectasis results from a desire to relieve a disgusting and disabling malady; to restore to efficiency a chronic invalid; and to reinstate among society an individual ostracized by the ever-present accumulation of a profuse and generally offensive expectoration. With this picture you are familiar. A man or woman, and not infrequently a child, somewhat emaciated, generally anemic, reticent, tired, practically useless, and preferring isolation. In the clinic you gather the students around this pitiable curiosity, passing him a porcelain cup. Even the ignorant foreigner solves your meaning, and by means of any number of several gymnastics empties his chest into the cup and returns it to you under the astonished gaze of the student, who has received a lasting impression. But this is the picture of an advanced case. In the beginning the diagnosis is rarely made; often the patient is late in consulting.

Our limited knowledge of bronchiectasis is based on the study

of twenty hospital and private cases. We have learned something from the literature, essentially the German, and particularly from the discussions at such meetings as this of the German Surgical Congresses. Text-books contribute little; monographs are rarely devoted to bronchiectasis alone; a fragmentary share is devoted to this subject in papers on pulmonary diseases and their treatment.

The causes of this disease are varied and uncertain. I recall two originating in whooping cough, another from measles, three from inhalations of a lamb bone, part of a toy balloon, a tooth. Acute influenza, and influenzal bronchopneumonia are probably most significant in etiology. Chronic empyema is said to be a forerunner of bronchiectasis. Obstruction at some portion of the respiratory tract from foreign body, tumor, or disease, is doubtless generally contributory. But whatever may be the exciting cause, the influenza bacillus is generally, and I am tempted to say universally, present in the sputum.

No group of physical signs are typical of bronchiectasis. We could cite to you auscultation and percussion findings of several cases of bronchiectasis, the interpretation of which might be entirely consistent with empyema, pleurisy with effusion, chronic abscess, malignant disease, or actinomycosis.

Röntgenologists are insulted if told that the *x*-rays are valueless. When the etiology, history, and sputum examination shout the diagnosis of bronchiectasis, a plate may sometimes show a large cavity if previously emptied of secretion. This is thrilling, and converts the case into a so-called "beautiful" one. But when all signs and symptoms are confusion and subject to many interpretations, and we rush to the *x*-ray specialist, he cannot differentiate for us. He will demonstrate any or all of the complex of signs which the stethoscope has prophesied, but he is of little consolation in our dilemma.

Let the text-book writers then confess that the stethoscope and *x*-rays may be *confirmative*, but that the diagnosis must be made chiefly by exclusion of allied diseases, by the etiology, by the history of repeated winter colds resembling broncho-

pneumonia, by the nature, persistence, and quantity of the sputum, and by the presence of influenza bacilli.

In discussing treatment we will begin as usual by attacking the internist. He tries to effect a cure. Medicine fails, inhalation soothes, change of climate reduces the secondary bronchopneumonia attacks, hygiene contributes rather less than in other pulmonary diseases. If the surgeon says, "Let us have a try," the internist answers, "What have you done? What can you do? My patient is still alive; he is not suffering."

In answering this question we choose to divide the surgery of bronchiectasis and of several thoracic diseases into two chronological periods: the first up to 1904; the second since 1904, or the past ten years. The surgical results of the first period might well discourage the internist from transferring his cases of bronchiectasis.

Mosler, in 1873, excised five inches of the fourth rib, opening a cavity. The patient died. Autopsy showed other cavities undrained. Leyden and Koch, in 1882, drained two cases; one died; the other improved. Biss and Marshall, in 1884, operated for drainage. Death followed. Multiple cavities were found at autopsy. And so on. We read a long story of drainage operations in 33 cases with mortality of 62 per cent.

In other words, the surgery of bronchiectasis up to 1904 consisted essentially in drainage operations. When death did not follow operation, the condition generally remained unrelieved because of the multiple undrained cavities remaining. Those types of bronchiectasis not associated with cavity formation were not relieved, and many such cases died as a result of search for cavities which were not there.

The recent period of ten years witnesses certain developments. Nitrogen gas injected into the pleural cavity produces and maintains collapse of the lung. This artificial pneumothorax has been successful in phthisis. The technique is perfected. It is being employed in diffuse bronchiectasis.

Extensive rib resection—the pleuropneumolysis of Friedrich—has been employed to collapse the lung. Cases of bronchiec-

tasis thus treated are now recorded. Hence another therapeutic measure in bronchiectasis. Be the results what they may, we have a new direction of attack.

Ten years of persistent animal experimentation have established the technique of lung resection as a therapeutic measure in various diseases. During the first period before 1904 the applicability of resection therapy in bronchiectasis could not be tested, because of our reluctance to enter the pleural cavity in the absence of adhesions. Numerous methods have been devised to overcome the possible dangers of opening the non-adherent pleura. Intratracheal insufflation survives as the fittest method. Hence excisions of bronchiectatic lobes have been attempted, and an opportunity is thus offered to determine whether or not this excision may prove to be a successful method of attack. Experimenters have devised new methods of closing the amputated bronchus in the normal animal. Such technique may or may not increase the safety of lung resection in the diseased human lung; and yet the field is opened wider in the surgical therapy of bronchiectasis.

A fourth surgical therapy employed is restricting the blood-supply to a bronchiectatic lobe. The pulmonary arterial branch is ligated. Shrinkage of the lobe results. This method may prove of great value, if not complete in itself, at least as a preliminary to excision.

The last ten years, then—those years of the last period—have contributed at least four new methods of treating surgical bronchiectasis. The conscientious internist doubtless welcomed this advent, but still seeks to know whether the curative effect has increased. The remainder of this paper, then, will be devoted to a discussion of the more recent results of new therapy; and it behooves us to be conservative and accurate in our statements, not implying that our success is greater than it is.

Methods of establishing lung collapse are given much attention nowadays. In tuberculosis *lung collapse is effective*. Placing a phthisical lung at rest by collapsing it, tends to heal it. Connective tissue replaces tuberculous tissue in these cases

and cicatrization obliterates cavities. This same collapse therapy is being tried in bronchiectasis. Symptomatic relief generally follows the collapse. The residual sputum content of cavities and dilated bronchi and alveoli is diminished for the time being. In early cases in young adults this treatment will be curative. But in the advanced cases where the pathology consists in an actual change of structure, we entertain grave doubts as to the curative effect of collapse. A bronchus once dilated with thinning of its walls is probably beyond recall. We then deal with a permanent deformity, and the alveolar emphysema and general ectasis of the terminal bronchioles are probably not to be restored to efficiency by mere immobilization and lack of use.

Nevertheless, we must never exclude lung collapse therapy and we advocate its trial in every case as a harmless preliminary. There are two ways of collapsing the lung. Relaxing the chest wall by excising innumerable ribs will partially compress the lung. This is Friedrich's pleuropneumolysis operation. He insists that it is safe and effective, particularly in phthisis.

Luxembourg reports a successful result in this operation on a bronchiectatic case. We have tried it three times, with two deaths and one narrow escape. From three to four days following operation coughing is restricted by pain in the wounds. The secretions are incarcerated in the collapsed lung. They may reach the bifurcation and be reinhaled to the sound lung. Furthermore, that unexplained group of complications may occur which brings disaster in so many thoracic operations. It is a sudden combined insult to the respiratory and circulatory mechanism which frequently the individual cannot compensate.

Observe, however, that the safe method of collapsing the lung is by the injection of gas into the pleural cavity, thus producing artificial pneumothorax. It succeeds when the pleural surfaces are not extensively adherent. We grant that Friedrich does not advocate rib resection in preference to nitrogen injection, except in those cases where the adherent pleura prevents the entrance of the gas. But in view of the doubtful benefit of collapse

therapy in these advanced adherent cases, and mindful of the dangers of rib resection, we believe that when nitrogen injection fails, rib resection should also be abandoned and then resection of portions of the lung alone should be considered.

Artificial pneumothorax, then, should generally be attempted in bronchiectasis. Three years ago we described a reliable technique for nitrogen injection, and it is gratifying to see the progress of this pneumothorax therapy in America where it was originally presented by Dr. J. B. Murphy.

The third method of surgical attack is the one which has been regarded as the most promising, that of lung resection. The complete or partial removal of one lung in animals is an acknowledged safe procedure, as we have often demonstrated. In both the first and second periods of thoracic surgery, portions of the lung have been removed for malignant disease, actinomycosis, ecchinococcus cysts, abscess, and gangrene. The technique of exploratory thoracotomy is improved. The technique of treating the lung stump after amputation is improved. The complete removal of a diseased portion of the lung in bronchiectasis seems to be the ideal method of eradicating a pathological condition, the structural changes of which may be regarded as beyond repair. Only certain types of bronchiectasis, however, are amenable to the excision treatment. It is comparatively rare to find one lobe only of the lung involved and when more than one is diseased, excision must be abandoned, and one or another form of collapse therapy resorted to.

Portions of the lung and even complete lobes have been successfully removed in cases of bronchiectasis. Lenhart, Garrè, Körte, Krause, Kümmell, and Sauerbruch have all reported one or two successes. We have added one case, and Dr. Willy Meyer doubtless has more to contribute to the list of successful lobe excisions. A striking feature common to all but Garrè's case attracts our attention, namely, that the successful lobe excision followed a series of previous operations, and excision was eventually performed, not because it was the original intention of the operator, but because his first explora-

tion and attempted drainage of the lung was followed by empyema, by contraction of the diseased lobe, by plastic operations on the empyema cavity, and yet without relief of bronchiectatic symptoms. As a last resort the retracted lobe was excised successfully.

Now this is not the brilliant form of lung excision which the success in animals prophesied. An amputation at one sitting is the operation to which we have all aspired. Many patients with bronchiectasis have been lost in the attempt to accomplish this. Less than four have survived.

And it is upon this point of radical one-stage operation *versus* the several-stage procedure that controversy is bound to arise.

As the surgery of the thorax advances, we become more and more impressed with the unwillingness of the respiratory apparatus and the pulmonary circulatory apparatus to accommodate themselves to the opening of the thorax and the removal of a portion of the lung at one sitting. That such can be accomplished without death on the table, we admit. At the completion of this one-stage operation, however, only part of the dangers are over. Postoperative pneumothorax is today more threatening to life than the operative pneumothorax, the dangers of which latter we have learned to overcome by the use of apparatus. As to postoperative pneumothorax, on the other hand, the presence of air in the pleural cavity following lung resection leads to the accumulation of fluid; pneumothorax becomes a hydropneumothorax. In the presence of a bacteremia as a result of the previous infection, this fluid may become infected; or, thanks to the opening and treatment of the bronchi at the root of the lung, the cavity may have been infected at the time of operation. Such a subsequent infection interferes with the healing of the stump. Leakage of the bronchial stump may produce fatal mediastinal emphysema. Withdrawal of the fluid may be of temporary relief only. The remaining lobes of the lung on the diseased side are restricted in function, owing to the operative pneumothorax. There is a tendency to incomplete oxygenation of the blood. The lung of the sound side

is suddenly burdened with compensatory function. This compensation must be supplied by an already diseased patient with low resistance. The pulmonary circulation is disturbed. The right heart is overworked. The unequal pressure on the two sides of the thorax, by the well-known syndrome of Garrè and Quincke, results in a limited expansion of the sound lung at inspiration, and an incomplete emptying of the same at expiration.

It is this group of complications which are suddenly thrust upon a case of bronchiectasis when the removal of a lobe is attempted at one sitting. That a successful one-sitting excision may eventually be accomplished we do not deny; but we argue that the shock of complications following the necessarily sudden adaptation of the respiratory and circulatory apparatus to a one-stage operation, is obviated by accommodating the heart and lungs to altered conditions before the diseased lobe is actually resected. It does not follow that this preliminary work must be accomplished by several operations.

From these experiences and from the high mortality attending the one-sitting operation, we have learned the advisability of permitting the partial retraction of the lung previous to excision, in other words, allowing the patient to accommodate himself to the changed conditions of breathing and circulation before undergoing the added insult of lung amputation.

We believe that the preliminary retraction of the diseased lung may be accomplished by any of the previously mentioned methods of collapse therapy—namely, rib resection, or artificial pneumothorax, or ligation of the pulmonary artery. Months later you may excise the lung. It is conceivable that all these methods may be superseded by the injection of fluid, not only to produce lung compression, but to produce adhesions of the lung in the contracted position, just as an infected pleurisy with empyema will produce the same result.

Of course the ambition of the thoracic surgeon is to perform amputation of the lobe of the lung as readily and successfully in the diseased human being as in the dog. His success in

animals has given him a proof of the possibility of such a radical procedure. Perhaps the success of animal experimentation in this direction has been misleading, and that we must allow that lung excision in the diseased human being is a very different proposition, and one not to be executed in the same fashion. As regards bronchiectasis, then, we propose the following conclusions:

1. Granted that bronchiectasis is commonly the result of bronchial obstruction by foreign body, tumor, or disease, the first indication in therapy should be the removal, if possible, of this obstruction. Bronchoscopy for the removal of a foreign body has not infrequently arrested bronchiectasis.

2. In the earlier stages of bronchiectasis, nitrogen gas injection producing artificial pneumothorax is indicated, and should always be tried.

3. Pleuropneumolysis, or extensive rib resection, is a dangerous procedure, with additional dangers in bronchiectasis. It should be employed only when adherent pleura prevents the introduction of nitrogen gas. Even then it is a dangerous procedure, and one of doubtful value.

4. In late cases of bronchiectasis, when the disease is obviously confined to one lobe, lung resection is the sole hope of surgical cure. The attempt at lung resection at a one-stage operation has been attended with high mortality. Occasional successes do not prove that the one-stage amputation will become the method of choice. For the time being at least, the general surgeons should first produce compression of the lung by artificial pneumothorax or pulmonary arterial ligature; second, and much later, he should excise. Meanwhile let us hope that the student of *thoracic* surgery will develop the one-stage excision.

THE INTERPLEURAL EXPOSURE OF THE HEART BY MEANS OF LONGITUDINAL SECTION OF THE STERNUM

By PROFESSOR REHN
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INFECTION of the pleura is the most important factor in the mortality of heart wounds. The next most important factor is the great bleeding during the operation. There can be no doubt that avoidance of injury to the pleura greatly decreases the danger of infection in operations for heart wounds. It is not necessary to say that the original wound in the great majority of cases opens the pleura, a consideration which has no place here. It is quite different if only a small prick or scratch wound of the pleura exists, which is almost negligible, or if the pleura has been opened wide first by our operation. But I grant that the operative methods heretofore in use are not adapted to promote the protection of the pleura.

The method which I warmly recommend gives, in every case, the greatest, if not absolute, safety that the pleura remains unopened during operation. It also gives us the possibility of immediately controlling the bleeding of the heart, in that we can reach both venæ cavæ and lessen the supply to the heart as desired. This method is finally useful for all sorts of heart injuries. Naturally, this recommends itself for other penetrating wounds in which under all circumstances the pleural cavity must remain sealed.

OPERATION. The incision is made from the left second chondrosternal articulation to the middle of the xiphoid process, then it follows the left costal arch; the latter incision is deepened.

rectus and transversalis abdominis are cut, and the incision continued along the under surface of the costal arch and the sternum above. The finger easily separates the delicate fibers of the diaphragm and enters the mediastinum.

Even with the great variation in the limits of the mediastinal pleura we will, in the manner indicated, be able to enter the retrosternal space.

The xiphoid process is now either pushed aside or removed. Now a well-rounded saline sponge is pushed up into the mediastinum. This pad now pushes the pleura out of the way on both sides and insures the safe splitting of the sternum up to the third or even second chondrosternal articulation. The divided sternum is then forcibly held back by hooks and the pleura protected by gauze. When necessary the pleural folds are retracted by means of the gauze. (Care must be taken not to attempt to retract the pleura with the fingers, as it is easily perforated). If the thorax is very rigid, the sternum must be divided transversely. The anterior surface of the pericardium is now freely exposed and one can open it as far as desired. The heart is just as easily accessible, and the incision offers us an especially good opportunity to compress the venæ cavæ.

After completing the operation the breast-plate section can be readjusted by several bone sutures. The pericardium should be closed by interrupted sutures which should not be taken too closely together, so that any fluid exudate can escape between the sutures. The mediastinal space must be drained and this in the absence of air (elimination of air by the negative pressure in the mediastinum). The space is walled off after a few days, when emphysema of the mediastinum is no longer to be feared.

I have now used this method six times, and it has always been satisfactory. I would even consider it applicable if a complicating serious wound in the thorax would subsequently require a wide opening in the pleura. The reason for this is obvious. A more or less incipient pleural infection will not easily be able to spread over the pericardium which has been walled off by the mediastinal pleura. But if one has operated on the pleura with-

out care, then heart, pericardium, and lung lie in the same space and will become infected simultaneously.

The method seems to me to be indicated in the following conditions:

1. In all heart wounds.
2. In the freeing of the heart as required.
   - (*a*) In pericardial adhesions in childhood.
   - (*b*) In callous mediastinal pericarditis.
   - (*c*) In certain malformations of the thorax.
   - (*d*) In resection of the pericardium followed by a plastic operation with a flap of fat (to overcome the partial restriction of the heart from pericardial adhesions).
   - (*e*) In chronic tuberculosis.

As an example, I will cite two cases of gunshot wounds of the heart:

Of greatest practical importance is the occurrence of pericardial adhesions in childhood. To all experienced pediatricians is this ominous illness known. There is not only the pseudopericardial cirrhosis of the liver (Tirk) but also severe marasmus, which reduces the children almost to a tuberculous condition. The clinical picture shows the enormous dilatation of the heart and cardiac insufficiency, with death-like pallor of the patient from diminished hemoglobin. Until now the child specialists ask themselves what might be the cause of the anemic course, blood-condition, edema, etc. The reason lies, as I have found, in the fact that the fixed dilated heart between the sternum and spine is subject to pressure. It cannot meet the requirements made by the growth of the child. For this reason the children cannot hold their own. There exists, therefore, the absolutely compelling indication to make room for the heart. This indication can be met with success by splitting the sternum. Example, Marie Thiele.

CASE I.—Diefenbach, aged twenty-eight years, was admitted one and a half hours after he was shot with a Browning in the region of the heart.

Findings. Pale, after the shock due to transportation was over; pulse full, 70 per minute.

The wound, just under the xiphoid process; respiration free; small areas of dulness; cardiac dulness not increased; heart sounds clear and regular, but weak.

Three and a half hours after the injury, increasing pallor, marked slowing of pulse; abdominal walls tense; *x*-rays did not show any increase in the size of the heart.

Operation. First, laparotomy, then incision was increased to the midsternal region. The pleura is pushed aside easily without any injury. In the prepericardial space little blood; in the lower recess of the pericardium 250 c.c. of blood, partly liquid, partly coagulated, pushing the heart forward. The wound is seen on the under right side of the pericardium. After the pericardium is opened the right ventricle was seen to be wounded behind and to the right. Compression of the veins is unnecessary, as no blood issues from the ventricle. The wound is easily closed by two interrupted catgut sutures. The point of exit of the bullet is difficult to find, but higher up on the posterior wall of the right ventricle is seen a bloody mark as large as a half-dollar coin. The pericardium is closed by a few stitches far apart. Except for a considerable hemothorax, the right side having to be emptied often through a puncture, the recovery was undisturbed. On the ninth, tenth, and twentieth day after the operation the patient could get about, and eight weeks after operation he was dismissed; at the final examination the heart, pulse, and lungs were perfectly normal. Blood-pressure and pulse tracings were normal.

Case II.—Grossman, aged twenty-eight years, was admitted November 23, 1913, with a gunshot wound in the left side of the breast; it was one hour after the injury. The patient is very pale, conjunctivæ bloodless, tongue anemic, lips bluish red, ears, as well as skin of thorax to level of nipple, cyanotic; the veins of the neck are prominent, the nose is sharp, pale, and cold.

The patient is unconscious; the extremities ice-cold, cyanotic, and covered with perspiration. The respiration shallow and

slow; the movements of the thorax with respiration are slight.

Two and a half finger breadths to the inner side of the nipple line is the entrance of a gunshot wound which measures 0.75 cm. in diameter, covered by blackish gunpowder; a little dark red blood flows slowly from the wound. There is hardly any increase in the cardiac dulness. The apex beat is not palpable.

On auscultation only a single heart tone can be heard, which seems to be very weak and coming from a distance. No definite murmur to be heard. The radial pulse on right and left not felt; the carotid pulse just perceptible. The *x*-rays do not reveal any apparent increase in size of the cardiac shadow; the bullet is lodged in the right pleural space at the level of the diaphragm.

Operation. Two hours after the injury. On retracting the halves of the split sternum, frothy blood flows from the prepericardial space. The whole heart and adjacent structures are easily seen after transverse splitting of the sternum at the level of the third rib. In the left pleura there is a small hole and an irregular tear in the heart region, from which rhythmically and under great pressure frothy blood sputters, increasing the laceration. From the shot wound in the middle of the right ventricle flows a very great amount of blood, but the flow is soon controlled through the digital compression of the venæ cavæ. The anterior wound is easily closed by five sutures and the bleeding is entirely arrested. The pulse, which was imperceptible before the operation, but became improved after the opening of the pericardium, became fluttering and thready during the compression of the veins, while during the handling of the heart it was entirely suspended.

After suturing, the heart, now placed in its normal position, beats at first only slowly and weakly, but gradually becomes stronger and increases up to 116 beats per minute.

The pericardium is closed by a few stitches far apart, and a tampon is placed in the precardial space and the wound closed up to the tampon opening. The operation lasted twenty-five minutes.

Course. Immediately after the operation the cyanosis disappeared, the consciousness returned, the respirations became free, 32 per minute, the pulse became full and regular. In the further course no noteworthy disturbances.

Twenty-one days after the operation the patient could leave his bed and eight weeks after the operation he was dismissed as cured.

Three and a half months after the injury it is found that the function of the heart is quite satisfactory; there is no sign of any marked insufficiency. The sounds of the heart are clear, the second pulmonic accentuated, the action regular; the pulse 92 to 96, 112 to 120 after going up stairs or after bending over, then also a gentle systolic murmur can be heard in the pulmonary area. The blood-pressure is 115 mm. Hg.

The illumination revealed lively pulsation of the pulmonary artery; there are no adhesions of the pleuritic or pericardial wounds; the diaphragm on both sides moves normally on respiration. There is no edema, no increase in size of the liver, no cyanosis, no bronchitis. The general condition is excellent; gain in weight, eighteen kilograms.

Case III.—Marie Thiele, aged thirteen years.

December 12, 1912. Beginning of polyarthritis rheumatica.

December 26. Admission to the children's clinic; insufficiency of heart, congestive bronchitis; swelling of the liver.

March 9, 1913. Reconvalescent after being sent to Nauheim. Two courses of treatment in Nauheim with bad end-results.

July 3. Readmission to the children's clinic. Enlarged cardiac area and murmurs; systolic drawing in end of the apex region; shortness of breath; cyanosis.

July 25. After administration of digitalis the symptoms of insufficiency decreased.

July 28. Admission to the surgical clinic. Examination on admission: pale, slightly cyanotic child with marked cardiac dilatation; systolic and diastolic murmurs over the mitral area; pericardial friction; liver enlarged; congestive bronchitis.

August 7. Operation: after separation of the sternum, wide flakey growths are seen between pericardium and epicardium; they are separated by the finger. The pericardium is lightly smeared over with sesamol. Closure of pericardium and thoracic wound.

August 9. On account of marked dyspnea, cyanosis and the pericardial effusion, which was suspected, the thoracic wound was reopened. No pericardial effusion was to be found. The margins of the thoracic wound are allowed to separate; extraordinary feelings of relief set in. From now on undisturbed convalescence. Temperature remains normal. Bronchitis and cyanosis disappear as well as subjective symptoms of disease. During four weeks hemoglobin percentage is raised from 49 per cent. to 69 per cent. Gain in weight, six pounds.

September 9. X-rays show isolated pericardial adhesions. General condition good; the child is up for an increasing number of hours each day.

Present Condition. Good general condition, gain of fifteen pounds. Constant improvement. General findings: subjective as well as objective, excellent; weight on admission, 34.300 kg.; on discharge (March 15, 1914), 45.000 kg. Size on admission, 1 m. 40; on discharge, 1 m. 55.

PRELIMINARY REPORT ON COMPOUND FRACTURES

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THE almost insuperable difficulty of obtaining reliable and full data from the profession has compelled the reporter to compile from his own clinic at St. Luke's Hospital, the cases herewith presented.

These cases are taken from the records of the last five years and represent the cases which could possibly be traced and the final results definitely determined.

As they are the product of only one hospital they cannot be taken and are not offered as fully representative of the methods and results of the profession, generally, in the United States. This is, therefore, but a contribution to the fuller investigation, which it is hoped will be presented at a subsequent meeting of the Association. Fifty-one cases are analyzed. They represent the following classes:

Compound fracture of the femur	8 cases
Compound fracture of both bones of the leg	15 "
Compound fracture of the tibia	10 "
Compound fracture of the patella	2 "
Compound fracture of the metatarsal bones	2 "
Compound fracture of the humerus	4 "
Compound fracture of both bones of the forearm	7 "
Compound fracture of the radius	1 "
Compound fracture of the ulna	1 "
Compound fracture of the humerus, radius and ulna	1 "
Total	51 "

28 cases were plated
7 " were wired
} Direct fixation of the fragments.

35 " had direct fixation of the fragments.
13 " were treated with external fixation only.
3 " were moribund when admitted and died within a few hours after admission. (No special treatment and not enumerated further.)

The plated cases were as follows:

Compound fracture of the femur	7 cases
Compound fracture of both bones of the leg	12 "
Compound fracture of the tibia	5 "
Compound fracture of the humerus	4 "

The wired cases were as follows:

Compound fracture of both bones of the leg	2 cases
Compound fracture of both bones of the forearm	3 "
Compound fracture of the humerus and both bones of the forearm	1 "
Compound fracture of the patella	1 "
Total	7 cases

The external fixation apparatus was practically the same in all cases, namely, a reinforced gypsum splint carefully moulded over a thick dressing of sterile gauze and cotton wool.

Average length of confinement in bed:

Forearm cases	6 days
Humerus cases	11 "
Leg cases	28 "
Femur cases	38 "

Average time in the hospital:

Forearm cases	23 days
Humerus	48 "
Leg cases	53 "
Femur cases	69 "

The average length of time the patient was out from work, that is, until he returned to his occupation:

Leg cases	6 months
Femur cases	13 "

For the upper extremity fractures the time of disability has not yet been thoroughly worked out; it seems to be about four months.

All the cases, but three, who had direct fixation were operated within forty-eight hours.

Two cases of compound fracture of both bones of the legs were plated on the fifteenth and eighteenth day after injury respectively, because the fragments could not be kept in place.

The case of compound fracture of the humerus and both bones of the forearm was wired on the tenth day after injury, also because by other means the fragments could not be kept in apposition.

Though compound fractures should always be regarded as infected wounds, it is noteworthy that it is recorded of these cases that but two which were fixed by direct applications to the bones suppurated.

One compound fracture of the femur, plated, had a streptococcic infection, but made a good recovery.

One compound fracture of the humerus, radius, and ulna suppurated from a mixed infection but also made a good recovery.

Not one of the direct fixation cases died.

Results. Of the forty-eight cases treated, there were two deaths, both from septicemia. One case, a compound comminuted fracture of the femur with very extensive injuries to the soft tissues, should have been amputated, but the patient refused amputation and died on the fourth day from acute sepsis.

The other case was a prolonged septicemia from mixed infection in a man who had a compound fracture of both bones of the leg, for which no direct fixation was done.

Mortality, 4.16 per cent.

One case of compound comminuted fracture of the bones of the leg with dislocation of the ankle-joint had a mixed infection, destruction of the joint and tarsus followed; an amputation was necessary.

Of the forty-six cases who left the hospital, all but one had useful limbs, that is to say, the one noted above which was amputated. 40.32 per cent. of these cases have returned to their former laborious occupations and report that they notice no disability.

Skiagrams are taken in cases of compound fractures:

1. After the first permanent dressing.
2. After the fixation plates have been removed.
3. When the union seems complete.
4. When the individual has returned to his occupation.

The number of cases is too small for any set conclusion in regard to the treatment of compound fractures, but certainly in this small series direct fixation has produced much the quicker recoveries, and far better results than the former conservative methods.

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